PHILIPPINE AGRICULTURAL REVIEW

16-17

1923-24

The Philippine
Agricultural Review

VOL. XVI | FIRST QUARTER, 1923 | No. 1

TOBACCO GROWING IN SUMATRA

By Domingo B. Paguirigan

INSECTICIDES FOR LOCUST EXTERMINATION

By Arsenio Goco

THE SUGAR CANE PROJECT OF THE BUREAU OF AGRICULTURE

By Silvestre Asuncion and Melquiades Medina

A QUARTERLY PUBLICATION

ISSUED IN ENGLISH BY THE
BUREAU OF AGRICULTURE

The Government of the Philippine Islands
Department of Agriculture and Natural Resources

Subscription rates: ₱2 (Philippine currency) or $1 (U. S. currency) per annum in the Philippine Islands and the United States and territories.
$2 (U. S. currency) per annum in foreign countries

MANILA
BUREAU OF PRINTING
1923

(Entered at the Post Office at Manila as second-class matter)

(Courtesy of "EL TRABAJO")

Hon. RAFAEL CORPUS

Re-appointed Secretary of Agriculture and Natural Resources

Formerly Delegate from Zambales to the Philippine Assembly; Solicitor-General; Director of Lands; Under Secretary of Agriculture and Natural Resources; Manager, Yangco Steamship Company and other business concerns of Mr. Teodoro Yangco; and recently elected by the Board of Directors, President of the Philippine National Bank.

THE PHILIPPINE

Agricultural Review

VOL. XVI FIRST QUARTER, 1923 No. 1

TABLE OF CONTENTS

	Page.
1. Tobacco Growing in Sumatra, by Domingo B. Paguirigan	3
2. The Manufacture of Havana Cigars, by Domingo B. Paguirigan	12
3. The Sugar-Cane Project of the Bureau of Agriculture, by Silvestre Asuncion and Melquiades Medina	22
4. Methods of Plant Breeding in General, by Nemesio Mendiola	30
5. Some Notes on Rice Hybridization Work, by J. P. Torres	46
6. Insecticides for Locust Extermination, by Arsenio Goco	49

ILLUSTRATIONS

PLATE I. Hon. Rafael Corpus, re-appointed Secretary of Agriculture and Natural Resources .... *Frontispiece.*

Facing page—

II. (*a*) Clearing land which had been allowed to lie fallow during seven years in Sumatra 4
(*b*) Spraying seed beds with arsenate of lead. Note the cheese-cloth covered beds on the background 4
III. (*a*) Grass and palm covered seed beds in Sumatra 5
(*b*) A closer view of the same seed beds 5
IV. (*a*) The rows are spaced alternately 8
(*b*) The curing shed at the Tobacco Experiment Station, Medam, Sumatra.... 8
V. (*a*) Flowers of mother plants are bagged with cheese-cloth to insure self-pollination 9
(*b*) Topping is practiced as a rule 9
VI. (*a*) A Chinese coolie carrying harvested leaves in convenient baskets to the drying sheds 8
(*b*) Harvesting is done only by priming 8
VII. (*a*) The leaves are strung 50 to a pole, face to face and back to back as in the Island of Cuba 9
(*b*) A typical tobacco curing shed in the plantations 9
VIII. Carefully classifying the leaves according to length 10
IX. (*a*) Interior view of a fermentation shed showing fermentation piles 11
(*b*) The process of baling 11
X. (*a*) Showing interior detail of curing house 12
(*b*) Showing method of piling leaf tobacco for fermentation 12
XI. (*a*) Appearance of the hands after being baled 13
(*b*) A lone cigar-maker and his outfit 13
XII. The *despalilladora* department or stripping department of a factory 14
XIII. Showing how scrupulously wrapper leaves are sorted in a Havana cigar factory. This operation is called *rezagando* 15
XIV. The cigar-makers at work 18
XV. A reader in a Havana Cigar Factory 19
XVI. Labeling cigar boxes, Cuba 18
XVII. A giant pineapple produced at the *hacienda* "El Porvenir" 19
XVIII. A view of the sugar booth at the Carnival Industrial Exhibition 46
XIX. Another view of the sugar booth 47
XX. Defoliated corn after a few hours of infestation 48
XXI. Defoliated coconut trees after a few hours infestation 49
XXII. Defoliated bamboo after a few hours infestation 50
XXIII. Methods of poisoning the locusts and hoppers in the evening 51
XXIV. (*a*) Swarm of hoppers 52
(*b*) Locusts resting on coconut pamls 52
XXV. Pit and corral method of killing locust hoppers 53

TEXT FIGURE

FIG. 1. Diagram showing alternate or quincunx method of planting tobacco in Sumatra.. 5

TOBACCO GROWING IN SUMATRA

By DOMINGO B. PAGUIRIGAN, *In charge, Tobacco Investigations*

The tobacco industry in Sumatra is famous because of its being very highly specialized. In Sumatra there are only planters—there are no factories nor brokers. And the efforts of the planters are wholly and absolutely directed to the production of wrapper leaves. After the leaves have been fermented, they are baled and shipped directly to Amsterdam, only.

SOILS

Tobacco is grown in selected lots in the northern half of the east coast of the island on the coastal plains facing the Straits of Malacca, about twenty to thirty miles on which are very nearly level, and to some extent in the rolling country near the mountains. Farther from the sea the land becomes rolling and finally rises to mountainous districts with peaks five to ten thousand feet above the sea level.

Close to the sea and along the rivers crossing the plains, the land is swampy. The larger part of the plains and much of the rolling country is suitable for cultivation, though by no means all of it has been brought under cultivation, as there are large tracts of virgin forests. The work of reclamation, however, is rapidly progressing.

In the lower level parts of the region the soil is either a stiff clay or a sandy loam. A heavy loam is found in the rolling and mountainous parts of Atjeh. In the high parts is found a sandy loam or volcanic tufa.

CLIMATE

The temperature of the high region averages 27° C during the entire year. It does not usually go above 33° or below 21° in the plains. The rainfall is between 80 and 120 inches and is rather evenly distributed throughout the year. Near the mountains the precipitation may be as heavy as 150 inches in one year. The period of least rainfall is from May to August, inclusive, and that of the period from November to January. There is only a slight difference between the largest and the shortest day of the year.

SYSTEM OF FARMING

In Sumatra large estates are the rule. There are about 80 tobacco estates with an average of 75,000 acres each. Only 750 acres on each of these estates are planted yearly, the rest of the land lying fallow for a number of years after each cultivation.

The original clearing of virgin forest for the planting of tobacco is done much the same as for rubber. The tobacco land, however, is cleared for only one crop, after which the land lies fallow for seven or eight years before the planting of the next crop. Tobacco is planted among the stumps of the burnt-over forest. It would hardly pay to make a more thorough clearing for the one year of cultivation. On older plantations, where the original jungle has long been cut over, and rotted out, only an eight-year growth of young wood need be cleared. In such places, where the stumps are not so numerous, a tractor might be of service in the original plowing and harrowing of the soil. All field operations are at present done by hand, however.

SEED BEDS

The seed beds are prepared beginning with the second week of January for planting in the lower levels and in the upper levels about two weeks later. In the preparation of the beds, practically the same principles prevailing in other leading tobacco countries are observed in Sumatra. In Sumatra, however, owing to the abundance of insect pests, more attention is given to the care and management of the beds. Frail bamboo frames are erected to support the covers, which are either of cheesecloth, palm leaves or grass leaves. When cheesecloth is used, the framework with the exception of a slight elevation at the middle, has a more or less uniform height. When palm leaves or grass is used, a stronger and a higher support is erected. The sticks on one side are 3 to 4 feet high and on the other, 2½ to 3½ feet so that the roof slopes gently.

The prevailing size of the beds is about 4 by 20 feet, and they are very much raised from the ordinary ground level to insure perfect drainage. The beds as a rule are constructed so as to extend east and west lengthwise.

After about ten days the roof is removed during the greater part of the day in order that the young seedlings may start to harder, and, after about a month, they are removed altogether thus accustoming the seedlings to natural atmospheric conditions peparatory to transplanting.

In Sumatra the writer did not notice that the seed beds were sterilized in any way but perhaps the perfect drainage of

(*a*) Clearing land which had been allowed to lie fallow during seven years in Sumatra

(*b*) Spraying seed beds with arsenate of lead. Note the cheese-cloth covered beds on the background

(*a*) Grass and palm covered seed beds in Sumatra

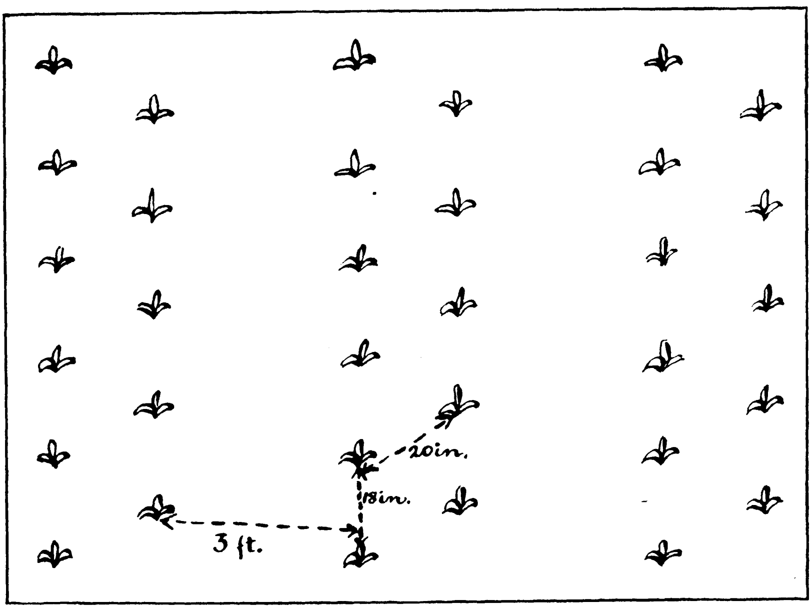
(*b*) A closer view of the same seed beds

the land as well as the uniform climate of the country jointly serve to check any material harm from fungous diseases. Insect ravages, however, are always the order of the day but any danger from this source is checked through the effectiveness of the application of arsenate of lead in liquid form as well as the daily vigilance of the active coolie laborers.

Of course the seeds are as sparcely sown as possible and considerable ashes mixed with the seeds, so as to insure healthy, stocky young plants. And to insure also a large supply of seedlings a series of at least 6 seed beds are prepared at intervals of about a week.

TRANSPLANTING

About fifty days after sowing, the young plants are ready to be transplanted. Transplanting operations are begun about the end of February and are carried on throughout June.



Scale: 1 ft. = 1 cm.

FIG. 1. Diagram showing alternate or quincunx method of planting tobacco in Sumatra. The closer distance between the rows serves to force intershading for the production of wrappers. The wider distance serves to facilitate cultivation and harvesting.

Because of the abundance of stumps, the tobacco fields are almost never prepared with field plows or field harrows. The land is worked entirely by hand and the long coarse native hoe called a *tjankol.*

The plants are set out in two different alternate rows which are respectively 3 and 1½ feet apart. In the rows the seedlings

are planted in holes 1½ feet apart, either oppositely or alternately; in other words in quincunx or in squares. The holes are about 4 inches deep and 3 inches in diameter. They are prepared usually the day previous to planting and wet just before the seedlings are set in.

The seedlings, which at the time of transplanting are about 6 inches high, are pulled only in the mornings when they are turgid. They are placed perpendicularly in convenient baskets and are deposited in the sheds until about two hours before sunset when they are ready to be set out into the fields. Care is always taken to press the dirt firmly around the roots of the young plants and until these begin to recover rigidity they are protected from the heat by thin wooden planks about 8 inches high and 4 inches wide, which are put over them tent-shape to shut out the noonday heat but the plants get all the sun during the morning.

CULTIVATION

Cultivation is performed at least three times before harvesting and all the work is done with the *tjankol.* After about a month the first cultivation is performed, which leaves a ditch about 4 inches deep between the rows. About two weeks afterwards, the second cultivation takes place. By this time the young plants are about 1½ feet tall, and the ditch is deepened in order to further insure perfect drainage. The third and last cultivation takes place when the plants are about three feet high. The last cultivation leaves the ridges still higher. A bigger ditch is also built around the field into which the smaller ditches empty, so that protection from any excessive rain is provided.

FERTILIZERS

As in the Cagayan Valley the use of fertilizers is rarely resorted to by the planters of Sumatra because as was pointed out at the beginning of this paper, the practice of allowing the land to lie fallow during at least seven years virtually makes it new land again. In certain cases, however, when plants are apparently suffering from defective nutrition, common organic fertilizers such as guano, wood ashes, manures, and cotton-seed meal are applied in moderation. These are usually mixed in varying proportions and applied in small ditches between the rows.

SUCKERING AND TOPPING

Suckering and topping are practiced as a rule. Suckering begins almost at the time of the second cultivation, when axillary buds begin to appear, and is continued through the harvest time. Incidentally the first sand leaves are removed before the

last cultivation and are left to rot on the ground. Ordinarily when the stand of crop is good, topping does not take place until the flower head is about half developed, that is, just before the first flower bud blossoms. Obviously, however, in the case of underdeveloped plants, the plants are topped low enough to allow the normal development of the remaining leaves.

DISEASES AND INSECT PESTS

There are about 27 recorded insect enemies of the tobacco plant in Sumatra, but the most common tobacco fungus diseases are also found in the Island, only the tobacco wilt as caused by *Bacterium solanacearum* is very important. Owing to the cheapness of labor, the worm are collected by hand only. The children on the plantations do most of this work and are paid only according to the number of worms captured. In addition the insect enemies are controlled by spraying the very young plants with arsenate of lead in powder form. Up to the present the Dutch workers in Sumatra have not as yet succeeded in checking the tobacco wilt but apparently with the discovery of *Mimosa invisa* as the only plant of easy cultivation which is resistant to the disease, the solution of the problem should not be far distant.

SEED SELECTION

The practice of saving seed for the next crop is the same in Sumatra as in other cigar tobacco countries. The finest, most vigorous and best looking plants are selected and the flowers are bagged with cheesecloth to insure self-pollination. The planters are very particular about the uniformity of the general appearance of the tobacco field, hence, although the seeds of various mother plants are used for the same field, strict care is taken to have these different mother plants as much alike as possible. Of course the men at the Deli-Proefstation constantly maintain variety tests and improve by pure-line selection promising native strains. The bagged seed is taken care of, dried and stored with all due care and precautions.

HARVESTING

Under normal conditions, the crop is ready to be harvested about two months after transplanting. Harvesting is finished by the end of May or June but may be delayed by unfavorable weather. Among the indications of ripening observed in Sumatra are the noticeable change in the color of the leaves to lighter, and the tendency of the leaves to become coarser. Because of the nearness of the curing sheds to the plantations,

wagons are hardly necessary and the leaves are transferred from the fields to the sheds in convenient rectangular baskets. Harvesting is done by priming which is distinguished from the methods of other countries in that only two leaves at a time are collected from each plant, at intervals of two days if the weather permits. The leaves are divided into four kinds regionally, namely, sand (lowermost), foot (lower standard), middle (upper standard), and top (uppermost).

CURING AND CURING SHEDS

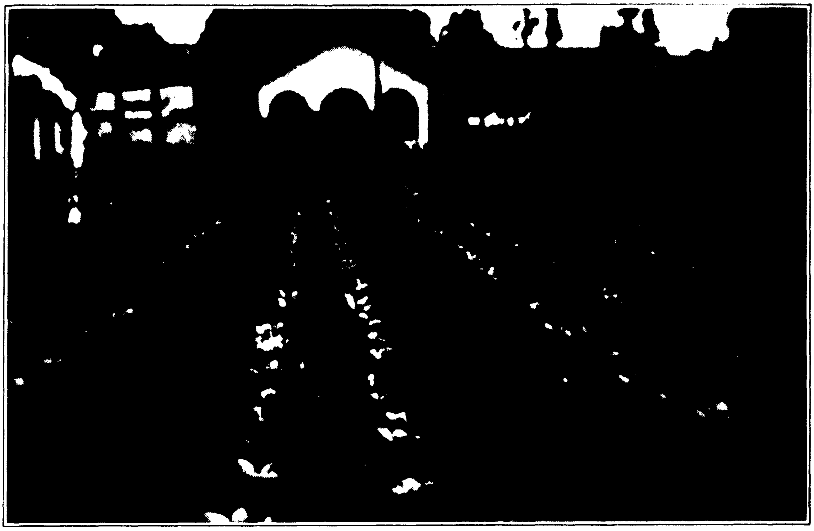
The ordinary or common drying shed is built of light materials. The typical shed is 72 feet wide, 180 feet long, 32 feet to the ridgepole and only 9 feet to the eaves. In all two hundred and seventeen posts are used and these are placed in seven rows of 31 posts each. These being sunk 4 feet in the ground, the row in the center has posts 36 feet long, the next two rows on either side has each post 28 feet long, the next two, posts 20 feet long and the last two, posts 12 feet long. The sides are practically made of windows (4 x 5 feet) and doors (4 x 8 or 9 feet) which can be easily opened or closed at will as required by the ever-changing weather conditions during curing.

The leaves are strung and poled in the same style as the shade-grown Cuban and as in Connecticut, that is, with the needle and a convenient string, fifty leaves are pierced back to back and face to face, the ends of the string are tied securely to a slender but strong wooden pole, and the pole is hung on racks 5 or 6 feet apart. The poles are so placed on the racks that the leaves of different poles do not touch each other. The curing process usually lasts from 20 days to 2 months.

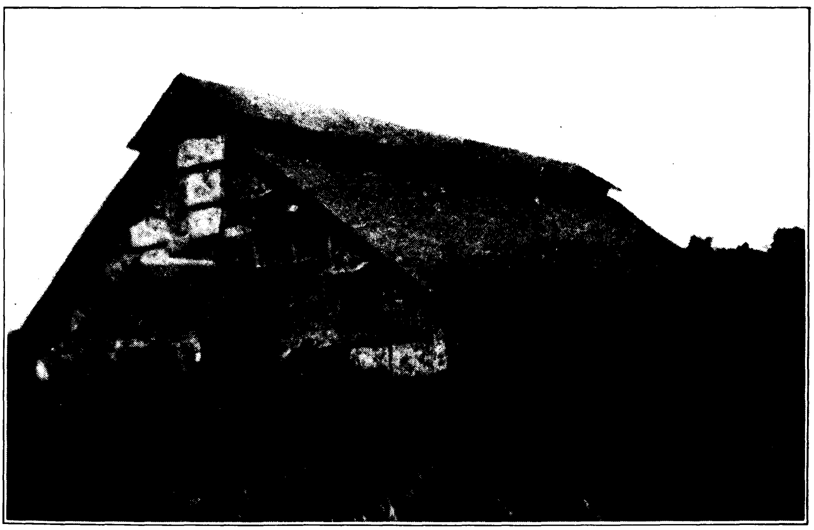
The size of the shed described is sufficient to cure the leaves harvested from about 50,000 plants. Because of marked humidity during the early hours of the morning, the doors and windows are not opened until about 9 o'clock. In case of heavy or strong winds and continuous wet weather, the sheds are kept as tightly closed as possible and to prevent pole sweat or rot, the interior of the sheds is heated with wood or charcoal which produces little or no smoke. The wood is placed in a hole in order that the fire may get the benefit of a draft. The fire is kept active only from sunset to the time the windows and doors are opened the following morning should the weather permit.

FERMENTATION

After the leaves have thoroughly cured they are ready to be removed from the poles, bundled into 50's and transferred direct to the warehouse, which is better known as "fermen-



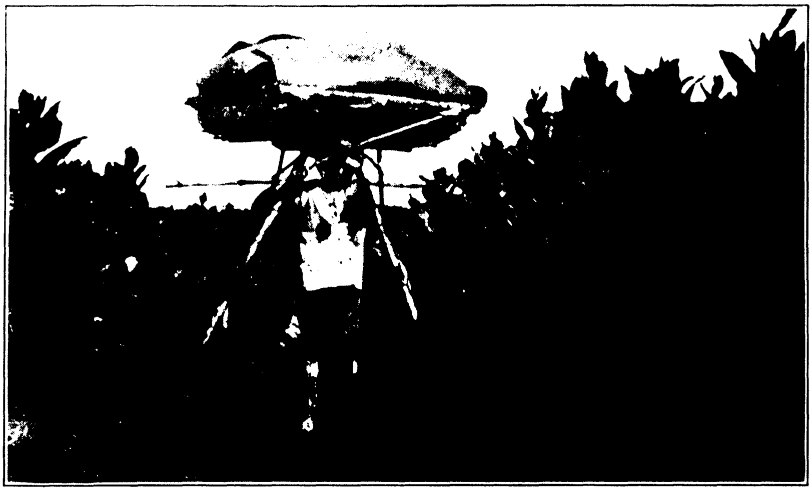
The rows are spaced alternately



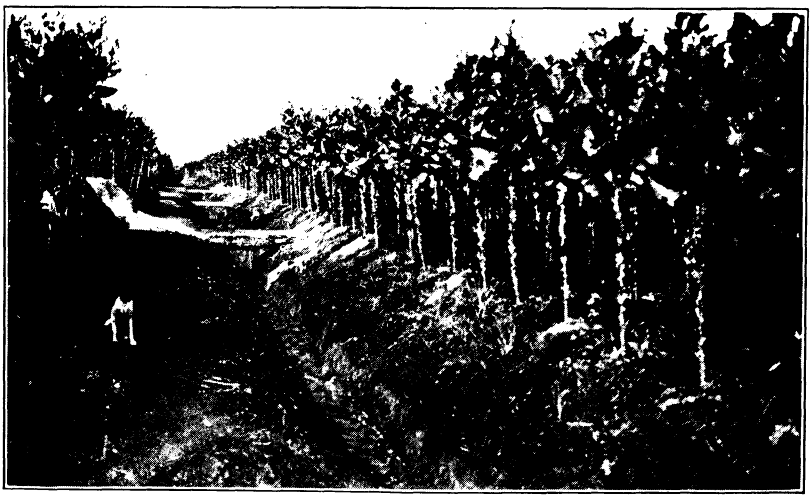
The curing shed at the tobacco experiment station, Medam, Sumatra

Flowers of mother plants are bagged with cheese-cloth to insure self-pollination

Topping is practiced as a rule

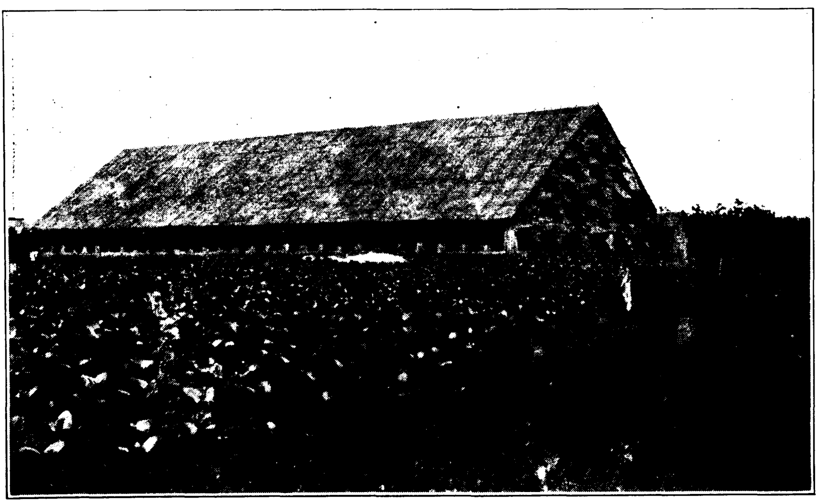


(*a*) A Chinese coolie carrying harvested leaves in convenient baskets to the drying sheds



(*b*) Harvesting is done only by priming

(*a*) The leaves are strung 50 to a pole, face to face and back to back as in the Island of Cuba



(*b*) A typical tobacco curing shed in the plantations

tation house" or "fermenting shed." This building is built of strong materials and is usually 240 feet long and 60 feet wide. It is also a perfectly rectangular building, with the exception of two porticos constructed at the doors on either side. It is 36 feet high and slopes on either side gradually to 10 feet at the eaves. The whole length on both sides is provided with glass windows so as to give plenty of light. A platform 180 feet by 30 feet is erected 3 feet above the ground in the middle of the shed where tobacco leaves to be fermented are put and left until they are baled. On one side of the platform, or on both sides there is left a space at least 15 feet wide and usually cemented, which is utilized for sorting.

There is also a projection of the building called the "receiving platform," ordinarily 30 feet square, which, as the name indicates, is used for receiving conveniently the leaves from the curing sheds.

Inasmuch as the tobacco crop in Sumatra is wholly wrapper, the main feature of the methods of fermentation prevailing is the bringing out of the characteristic properties of a wrapper leaf, which are hardly distinguishable after curing with the exception of the texture. These characteristics include even light color, glossy appearance, and elasticity.

In the first place the heat produced in the piles should be low and should not be allowed to increase rapidly. Leaves of different regions of the plant are not fermented together. Neither are sand leaves and trash mixed with sound ones. The ordinary method of fermenting is done by building a pile from 4 to 6 feet high and about 6 feet wide and 8 to 18 feet long, with the petioles all pointing outward, and the corners fan-shaped. At first the heat generated is allowed to reach 38° C before it is rebuilt as in the beginning but this time the bundles change places so that those that were outside are placed inside and vice versa. In the first rebuilt pile, the temperature may be allowed to reach as high as 53° C. There is no fixed rule followed to regulate the number of times the piles are to be rebuilt but until the leaves do not show the desired wrapper qualities and until the temperature ceases to become constant, the operation is not stopped.

The novel method of fermentation now practiced in Sumatra consists of starting with small sized piles of leaves weighing about 30 pounds. These piles are rebuilt twice to 4 times, as in the ordinary way, the temperature never being allowed to exceed 48° C. Two of these piles are next combined so that the total initial number of piles is reduced to one-half. These

piles are rebuilt only once, after which they are also combined by twos and rebuilt only once. This arithmetical increasing of the size of the piles is carried on once or twice or more times until the fermentation process is considered complete. In no instance during the changing of the piles is the temperature allowed to exceed 53° C and in making of the piles of the highest grade leaves, hundreds of inferior grades are used to form the topmost as well as the bottommost layers.

The fermentation process usually lasts two months for the whole crop.

CLASSIFICATION

After fermentation the leaves are unbundled and classified very strictly as to—

a. Size.
b. Picking or region.
c. Color.
d. Soundness.

There are usually 4 sizes, namely: (1) 16 to 20 inches, (2) 12 to 16 inches, (3) 9 to 12 inches, and (4) 6 to 9 inches.

There are also 4 regional classification, namely: sand, foot (lower standards), middle (upper standards), and top.

The color classification includes: brown, dark gray, light gray, yellow, multicolored, slightly speckled, dark and brown slightly speckled, gray and light speckled all colors.

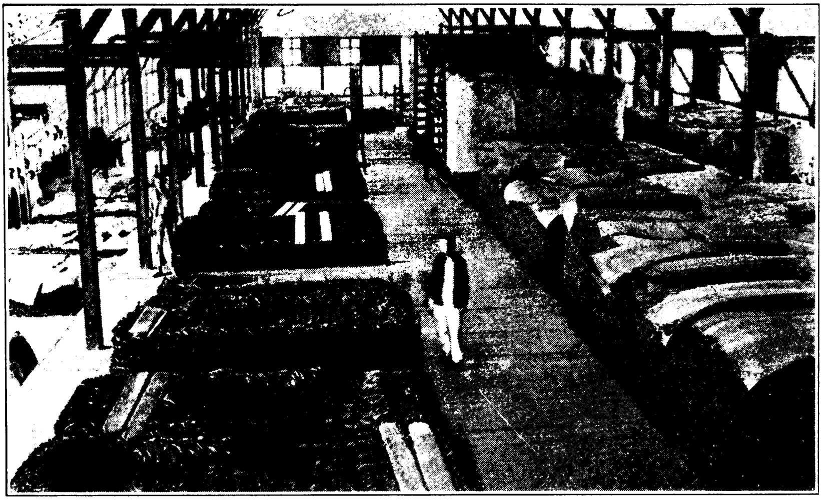
As to soundness, the leaves are grouped as: perfect, little broken dark and brown, little broken gray and light, much broken all colors, coarse but not speckled, sweepings and trash.

BALING

After sorting, the leaves are rebundled into 35 or 40 in each bundle, after which, they are ready to be pressed and baled.

The baling apparatus used in Sumatra is the same as that used in the Philippines, but the methods of arranging the leaves in the bales as well as the general handling of the apparatus are markedly different. Without counting the number of bundles, a lot weighing 80 kilograms is placed in a collapsible wooden receptacles 30 inches square and over 2 feet high and this slides under the press on rollers. Pieces of tightly woven pandan matting are placed above and below the receptacle after the bundles have been put in, with the petioles pointing outward. The receptacle is then placed exactly under the press, the iron cover is lowered, the sides are removed, and pressing is continued until the bale has been squeezed to about a foot in height only. Bales of Sumatra tobacco are of uniform size, that is, 30 by 30 inches by 9 to 12 inches in height depending on the

Carefully classifying the leaves according to length



(*a*) Interior view of a fermentation shed showing fermentation piles

(*b*) The process of baling

size of the leaves to be baled. The bigger the size the higher the bale.

When the desired height of the bale has been reached, the matting at the top and bottom are pulled together and sewed up. The bale is removed, marked with the grade and other identification marks and is ready for shipping. The method of regulating the pressure exerted in the baling of tobacco as observed in Sumatra and in Cuba undoubtedly is a very sound practice. The leaves are not deprived entirely of the necessary moisture for maintaining the so-called "life" of sound cigar tobacco in general and of wrapper tobacco in particular.

CONCLUSION

Perhaps the more salient unique features of the tobacco industry of Sumatra are the facts that the crops as a whole is marketed only in Amsterdam, Holland, that the planters have a very strongly organized union, and that the total yearly production is restricted always according to a prospective demand which has been very carefully studied. The production in 1921 was 12,606,960 kilograms or 157,587 bales although the normal production is 250,000 bales. The average daily wage including the expenses of bringing in the Chinese and Javanese coolies as well as their management and housing, amounts to one gulden (F 1) only or eighty centavos. The average cost of production of one pound of Sumatra wrapper is ₱1 or ₱1.20. Because conditions and factors governing the production of tobacco in Sumatra are radically different from those prevailing in the Philippines, it has not been deemed necessary to itemize the cost of production of Sumatra tobacco. But considering the fact that the Philippines imported in 1922, 82,132 kilos of tobacco wrapper valued at ₱514,140, it is indeed high time our growers should improve their methods.

ACKNOWLEDGEMENT

I wish to acknowledge my obligations to Mr. C. O. Spamer, American Consul at Medam, Sumatra; and to Dr. B. T. Palm and Mr. Ir. E. Sidenius, Director and Chief Chemist, respectively, of the Deli Proefstation for valuable information included in this report.

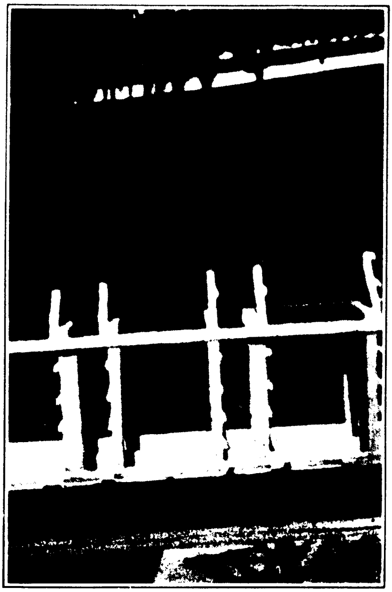
THE MANUFACTURE OF HAVANA CIGARS

By DOMINGO B. PAGUIRIGAN, *In charge, Tobacco Investigations*

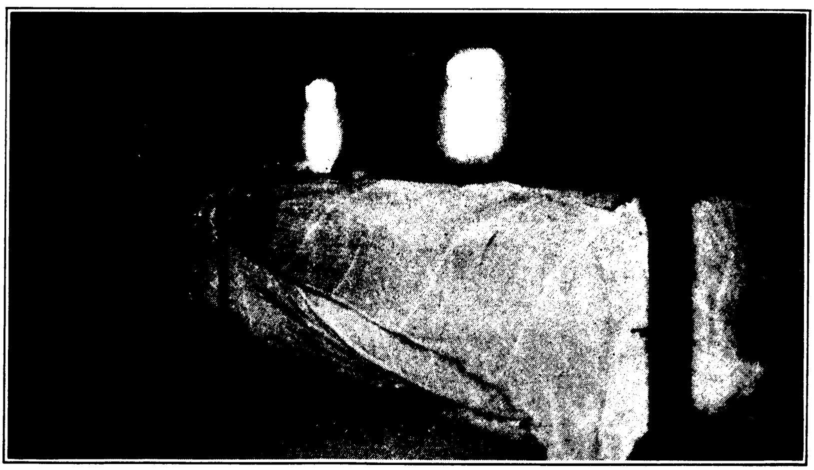
The present article has been prepared with the main object of presenting a brief but comprehensive account of the history of the making of a Havana cigar, to point out to those in the Philippines interested in our evergrowing important tobacco industry a few of the things, apparently immaterial, that nevertheless go far to make and maintain the fame of Havanas as the best cigars in the world.

A peculiar fact in connection with the manufacture of cigars is that absolutely no intricate chemical nor physical processes are involved, as in virtually all other modern industries; yet, notwithstanding the general simplicity of the process, only the most diligent and most patient manufacturers are successful. To be brief: the key-note to successful cigar manufacture consists of extreme care in observing every detail necessary in the process, in order that the identity or distinguishing characteristics of a "brand" or "shape" may be perpetually preserved or maintained. Smokers, as a rule, are very particular about this. The moment a smoker fails to notice the familiar taste, aroma, burn, etc., in his favorite brand, he begins to look for a substitute. Hence, in short, a manufacturer is successful only so long as he satisfies his customers, and the only way to do so has just been pointed out. It is perfectly plain, therefore, that in various instances, Philippine manufacturers have failed, and have been obliged to look for new customers, from time to time, for the sole reason that they have failed to manufacture a uniform product. It cannot be otherwise because tobacco leaves of the right quality for good cigars are available in the Philippines also. Indeed this fact is too obvious to require definite proofs.

In the first place, in connection with elaboration of a Havana cigar, it is assumed that the manufacturer, sometimes with the able aid of a confidential expert assistant, has already selected the suitable leaves (usually to be blended according to his secret formula). And only when a manufacturer knows the relative merits of the leaves as grown in different parts of the Islands, and how the crops are affected by the climatic conditions during each season, what fertilizers are used and how these were applied, and all the other details, big and little



(*a*) Showing interior detail of curing house



(*b*) Showing method of piling leaf tobacco for fermentation

PLATE XI

(*a*) Appearance of the hands after being baled

(*b*) A lone cigar-maker and his outfit

acquired only through long years of experience is he in a disposition to make the necessary selection and proper combinations for each particular blend desired.

In cigar manufacture there are three distinct forms or products of tobacco used, namely, wrapper (*capa*), binder (*capote*), and filler (*tripa*). The first and the last are specialized products; that is, each is grown especially for the purpose for which it is intended. The wrapper, as the word indicates, is leaf tobacco grown especially for wrapping cigars. It must therefore be uniform in color and as free as possible from blemishes and holes or tears. It must be very elastic, so that it can be wrapped smoothly and tightly around the cigar. At present light colors are in the greater demand. They are the fashion. The wrapper should be of the proper size and shape to prevent waste, and lastly, as far as possible without any definite aroma or flavor which could in any way detract from the desirable qualities of the filler. Although the thin wrapper used at the present time constitutes only about one-fifteenth or one-twentieth of the cigars, it may have a very marked influence upon its appearance—much more influence, apparently, on account of being plain to the view, than if the same leaf were put inside as part of the filler. The reason for this is not wholly apparent, but is probably connected with combustion products and the access of air. Certain it is that the flavor and aroma of the wrapper are always carefully considered in blending tobacco for high-prized cigars.

Filler tobacco is raised to form the main body of the cigar. The leaves must therefore be of good and rich aroma and agreeable flavor, and must burn freely and smoothly. Binder leaves are not produced in any particular way, however, but are taken from a crop of either wrapper or filler tobacco. These are used to cover or bind the fillers preparatory to final wrapping. They are usually, therefore, discarded wrapper or finer filler leaves.

BASES FOR CLASSIFICATION OF SHADE-GROWN TOBACCO

The sound leaves par excellence are sorted out according to size into three main groups which in turn are sub-divided into three main kinds of fineness:

A. 1st—	1a/10a. S (Dry),	1a/10a. F (Fine), and	1a/10a. MT. (Medium)	
2nd—	11a/12a S (Dry),	11a/12a. F (Fine), and	11a/12a MT. (Medium)	
3rd—	13a/ S (Dry),	13a/ F (Fine), and	13a/ MT. (Medium)	

NOTE.—There is no exact standard for size because the size of any one leaf depends on the season. Suffice it to say that the first group represents the largest, which are about 50 cm. in length, and the last represent the smallest or the most perfect and sound wrappers (from 1a/ to 15a/). "S" is the abbreviation for *Seco* or *Ligero*, "F" for *Fina* and "MT" for *Medio Tiempo*.

B. Leaves of the same sizes as above but which, due to some flaw or other, cannot be included in any of the A sets. They are designated as *rezagos.*

1st 1a/3a. *Rgo.* 1a/ S. *Rgo.* 1a/ F. *Rgo.* 1a/ MT.
2nd 4a/ *Rgo.* 2a/ S. *Rgo.* 2a/ F. *Rgo.* 2a/ MT.
3rd 5a/ *Rgo.* 3a/ S. *Rgo.* 3a/ F. *Rgo.* 3a/ MT.

C. Besides these, there are two other *Rezago* classes designated as *Rgo.* 6a/7a, that include the leaves not up to the 1a/5a class.

D. Still further extra grade, which is suitable as binder known either as 14a/ F. and 14a/ S. or 16a/ *Rgo.*

E. Likewise a clean grade of filler known as (15a/ or 16a/).

F. A type of filler known as *dispalillable* is also separated and is designated 16a/—17a/.

G. Two grades known as *Volados* are obtained:

Volado No. 1. Includes all large leaves which are chaffy, greenish (*volada, verdosa, sin vida y vaciada*). These can be fixed up so that they can be used for filler. A leaf may supply enough tobacco for a cigar.

Volado No. 2. Includes similar but decidedly smaller leaves.

Volado No. 1 are usually discards from the larger classes and should be inferior to *Rgo.* 1a/. *Volado* No. 2 are discards from the filler grades proper also and should be inferior to grade 17a/.

H. A filler grade of coarser texture is separated from the ordinary filler grades, 15a/ 16a. and is called 15a/ de *Calidad.*

I. Two grades known as *Quebrados:*

Quebrado No. 1 consists of the heavier or rougher leaves *Rgo.* 4a/5a.

Quebrado No. 2 consists of leaves under the same conditions but derived from other than the preceding. It is distinguished from the *Volados* in that the latter are of lighter texture.

J. Two grades known as *Sentidos:*

Sentido No. 1. Large partly decayed leaves.

Sentido No. 2. Small partly decayed leaves.

K. Two grades of clearcut yellow or very pale leaves:

Amarillo No. 1 (Large) and *Amarillo* No. 2 (Small).

L. *Bote* includes all that cannot be classified with any of the above.

BASES FOR CLASSIFICATION OF SUN-GROWN TOBACCO

A. 1a/15a. Includes clean leaves of sufficient size to furnish material for two cigars. They are also separated into two kinds as in shade-grown, viz., *Ligero* (L) or *Seco* (S).

B. *Rgo.* 1a/5a. Includes leaves of the size as the above but slightly damaged, and separated likewise into L. and MT.

C. *Rgo.* 16a. Smaller clean fillers with some flaw or other, and likewise separated into L (S) and MT.

D. 16a. Smaller clean fillers without any noticeable flaw and likewise separated into L. and MT.

E. 17a. Still smaller clean filler but not too small to be conveniently stripped. Also separated into L. and MT.

F. 18a. Bote fillers or all such leaves which cannot be included into any of the above nor into the grades below.

G. As in the shade-grown there are also two kinds of *Amarillos*, viz., *Amarillo* No. *1* or *grande* and *Amarillo* No. *2 Chico.*

The "despalilladora" department or stripping department of a factory

Showing how scrupulously wrapper leaves are sorted in a Havana cigar factory. This operation is called "rezagando"

H. *Rgo.* 1a/4a. M. Is the *maduro* (ripe) type of wrapper obtained from a crop of sun-grown tobacco. It is separated into *Grande* and *Chica.*

TABLE I.—*Number of leaves in each hand*

Representative grades	Number of leaves
1a/ 10a—*Rgo.* 1a	35
11a/ 12a—*Rgo.* 2a	40
13a—*Rgo.* 3a	45
14a—*Rgo*	60
Rgo. 4a	50
Rgo. 5a	55
Qdo. 1a	50
Qdo. 2a	55
Volado 1a	40
Volado 2a.......... In *gavillas* (¼ of a hand) *bultos.*	
15/16a.......... 8 ounces *gavilla*	
1a.... are baled in *gavillas* without being bundled into *manojos*	

TABLE II.—*Classification terms and equivalents*

1 *Tercio*	=	50 *cujes* (poles) in *mancuernas* (pair of sun-grown leaves harvested with stalk).
1 *Tercio*	=	110 *cujes* of primed leaves.
1 *Tercio*	=	550 *cujitos* (short poles) of primed leaves.
1 *Tercio*	=	80 *manojos* (hand).
1 *Manojo*	=	4 *gavillas.*
1 *Gavilla*	=	33 to 60 leaves of wrappers or binders.
1 *Gavilla*	=	6 oz. leaves of fillers.

HINTS UPON THE FERMENTATION OF CURED TOBACCO LEAVES

When the weather is markedly humid, the leaves harvested during the period from December to middle of January should be removed from the poles. The morning humidity should be taken advantage of and the leaves should be piled right away. Care should be taken that the leaves are soft enough so as not to break when handled. The piles for this same tobacco should be made low enough, and the temperature should never exceed 105° F.

It is very important to be cautious in the handling of the leaves harvested before the 15th of January, because they have been completely washed by the rains. As far as possible, any rise in temperature in the piles (*pilones*) or in the bales (*tercios*) should be prevented. It is the only way to save them. By observing this precaution it is possible to prevent the formation of any bad odor in the leaves as well as the wasting of the little body which they possess. As a matter of fact very little wrapper is available from leaves under these conditions.

In the packing and grading of this tobacco, great care should also be observed when spraying. Only the minimum amount of water should be used, so that the leaves will appear more dry than wet. In case of excessive humidity, no spraying at all should be done and the leave should not be handled until the humidity lessens. This kind of tobacco should never be baled under humid conditions, and if on account of the relative humidity, the tobacco house is filled with moisture, before baling, time should be allowed for the leaves to become rather dry. If these precautions are observed, as well as the other precautions necessary during packing and grading and baling by carefully separating the *volado* and the *vaciado,* it will be possible to escape having worthless as well as decayed tobacco.

Different precautions should be taken in handling tobacco harvested between January 20th and the 15th of February. The better grade leaves harvested during this period should be piled separately and contain more moisture (at least more wet than dry). The pile should be left standing for some time. For this reason thermometers should be employed, and the piles should be made slightly higher so that heat may actually be generated. The temperature should be gauged by the thermometer and carefully recorded at least four times every day—say at 6 a. m., 10 a. m., 2 p. m., and 6 p. m.

If the temperature starts to rise with undue rapidity, care should be taken to rebuild the piles before a rise of 15° is registered, so that the hands which were on top will be at the bottom and those in front in the middle or center, so that all leaves by the time there have been several rebuildings, will have been subjected to an equal amount of fermentation. When possible at the time the piles are being rebuilt, the chamber or room should be hermetically or at least tightly closed.

Classification and packing should not be started until the pile no longer generates heat.

For the leaves harvested latest, i. e., between the 20th of February and April (as well as for heavier leaves), more or less the same procedure should be followed. Considering, however, the fact that these leaves sometimes are very heavy, and heat is more rapidly generated, the piles must be rebuilt more frequently.

BALING

After the leaves have been classified, they are rebundled or retied in hands according to Table I. A hand is tied with raffia fiber which is wound around it spirally so that it becomes

fusiform in shape. The hand at the base of the leaves is tied with one of the leaves constituting the hand itself. The hands are then ready to be baled right away. As a rule when the weather permits, the classified leaves are baled the same day.

The baling apparatus is a simple thing. It consists of flat, rather heavy boards 2.5 meters long supported at the middle of its sides by heavier narrow boards 1.5 meters long. These are connected below the base board by two flat, thinner boards which pass through one of the side boards in order to increase or reduce the width of the apparatus according to the size of the bale to be made. At one end of the connecting boards are set alternately half a dozen holes for the purpose. The connecting boards are 1.2 meters long. On the top of the side boards are 4 slightly tapering small supports which are 15 centimeters apart. Between these supports are a pair of sticks to hold the string for tying the bundle. These supports are 60 centimeters high and 4.5 centimeters square at the top. The two centers have removable sticks with which to hold firmly a broad petiole of the royal palm (*Roystonia regia* Cook.) which is the material used exclusively in the baling of tobacco leaves in Cuba. The rope used to tie the bales is derived from the fibrous cortex of a malvaceous plant commonly known as majagua (*Hibiscus tiliaceus*, Lin.). Four pieces of royal palm petioles are required ordinarily for packing a bale of Cuban tobacco. A piece of these petioles is usually 1 meter by 1.5 meters. As these materials are very strong and very compact, they are ideal for the purpose, besides being cheap and abundant.

A bale always contains only 80 hands irrespective of its grade. The hands are arranged in two layers with the butts of the leaves pointing towards the ends of the bales. The upper and lower layers contain 13 hands each and the central layers 14 hands.

The main feature of this process is that the leaves are not actually pressed by machinery. Only hand pressure is employed. This method is very sensible inasmuch as the moisture which is vital in the conservation of the so-called "life" of the leaf tobacco is not squeezed out. It is possible that the pressing of Philippine tobacco to the limit, I may venture to say, by the use of powerful mechanical apparatus, is responsible for the deficiency in aroma and flavor so justly complained about by American jobbers, and smokers. Indeed, practically all Philippine leaf tobacco examined by the writer while in New York

City is wanting in the elastic or pliable property which is an obvious indication that a leaf is not "dead" but "alive."

A bale of Cuban tobacco is usually 65 centimeters long, 65 centimeters wide, and 40 centimeters high.

MANIPULATION OF LEAVES PREPARATORY TO ROLLING OF CIGARS

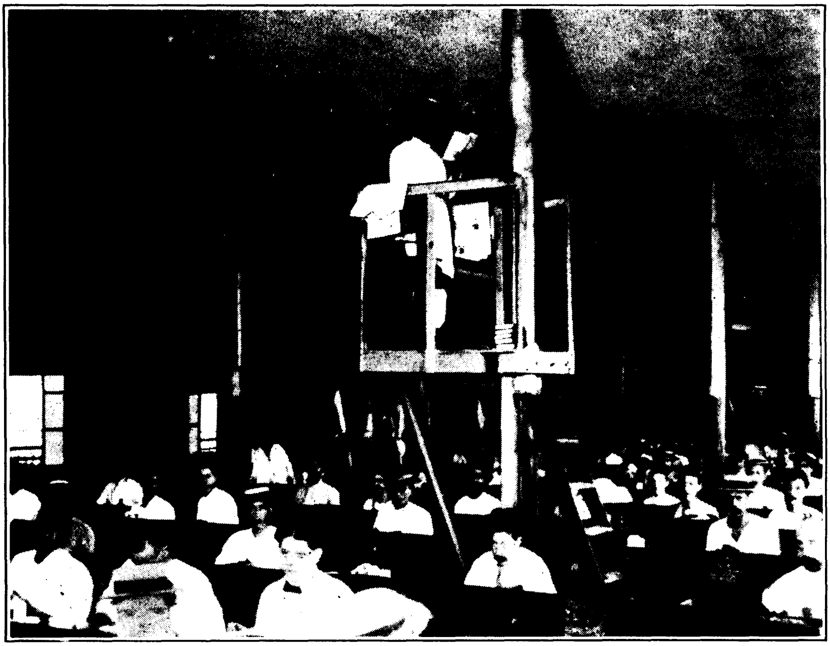
It is a well-known fact that the wholesomeness of a smoke increases with age. But a crop of a certain season if light enough may be available for manufacture following the baling process. Heavier leaves, naturally, require at least one or two years of storage before they are disposed of to mellow properly.

Let us first consider the manipulation of the fillers. When the leaves are removed from the bale, not being as pliable as required by the strains incident in the making of a cigar, they are first plunged into a tank of clean water and then shaken out. Next they are taken into the stripping department, where they are placed on stands (*oreales*) during at least two hours to allow any surplus water to evaporate. Then the midribs from the base to about three-fourth the length of the leaf, are removed. This operation is usually performed by women and girls. The stripped leaves are again placed on stands in layers of as many leaves as there are in one hand, which depends, of course, on the grade being worked (see Table II). The leaves are laid out flat and pressed between boards which further flatten them during the next 24 hours.

The partially dried leaves are next put into ordinary barrels of the kind used for refined sugar, precautions being taken always to see that they do not get mixed into the wrong class. These barrels are ordinarily 75 centimeters high, 30 centimeters in diameter at the center and 40 centimeters at the ends. At the central girdle, 5 holes, more or less equidistant and 2 by 5 centimeters round are bored. These serve to prevent too rapid fermentation. The leaves are kept in these barrels from 15 days to 6 months depending on the texture of the fermenting leaves. As a rule, as long as the interior of the mass are at all warm the leaves are not really ready for use.

The wrappers being of very little body and almost neutral in taste, are not subjected to the extra process of fermentation just described. Havana wrappers are so expensive that an estimate is made of the quantity necessary for the day's output, and that quantity only is moistened the day before it is needed. Another instance of the scrupulous care taken by the Cuban manufacturer is the fact that the wrappers are reclassified before they are finally used, and this time, more strictly. The

The cigar-makers at work



In Havana cigar factories, the cigarmakers contribute among themselves sufficient money to pay a "reader" who reads to them during the working hours the important dailies and weeklies and if time permits he also reads in a series the best selling novel of the day.

Labeling cigar boxes, Cuba

A giant pineapple produced at "El Porvenir," a *hacienda* owned by the Lichauco family in Tayug, Pangasinan. This fruit is 1 foot long and 8 inches in diameter and weighs 13 pounds. The variety is the Smooth Cayenne, imported by the Bureau of Agriculture from Hawaii.

special wrapper selectors are called *rezagadores*. The wrapper leaves distributed are all strictly accounted for and are given to the cigarmakers in lots of 25's and one receipt only. Hence the cigarmaker gets his fillers and wrappers separately.

THE ROLLING OF A CIGAR

It is scarcely necessary to point out that the operator gets his materials according to the quality, color, and texture which the kind of cigar (*vitolas*) he has to make, needs. He is now ready to proceed first by choosing from his supply on hand, a sufficient amount of filler which he binds with a suitable binder (*capero*). The fillers are arranged longitudinally, so that the smoke may be drawn freely from end to end and the cigar burns evenly. After consolidating the filler rolled in the binder, the outer wrapper, which has been trimmed to proper form with a flat keen-edged knife, is wound around it spirally, beginning at the thick end and worked down to the tapering butt, where it is twisted to a fine point and secured with tragacanth paste. After cutting the cigar to the required length and rolling it to roundness with the same flat knife, the cigar is ready to be turned over to the foreman. A very good machine, called in Spanish *máquina para cortar boquillas,* is manufactured by the National Pelling Co. of Allertown, Pa., U. S. A. with which to cut cigars to the desired length.

Machinery for the rolling of cigars is never used in Cuba although such machines are used extensively in the United States.

Ordinarily, a Cuban cigarmaker can make as many as 200 cigars per day and at his best, he can raise his output to as high as 300. On the following morning when the cigars have been delivered to the sorting room or *escogidas,* they are spread out on tables for examination as to their size and workmanship. The duties of the man in charge of this work are of a very important nature and in nearly every case the keen judgment of these selectors is inherited, their fathers and their grandfathers before them having followed the same calling. If there is the slightest variation in quality of the finished cigar, the selector discovers it, and all imperfect work is rejected and thrown out. These rejections, known as *rezagos,* are usually disposed of among the factory employees and their friends. Not only does this selection work require a very critical eye, but it must be done under a strong north light, and in each factory may be noticed high screens placed over the sorting tables in order to obtain the desired steady light.

The cigars having been carefully examined and measured with regard to length, thickness, when found correct are put into large cupboards made of old, well-seasoned cedar-wood, which are slightly ventilated so that any excessive moisture remaining in the tobacco may evaporate. Here they remain until a sufficient number of a given size are ready to be packed, or until orders are received from abroad, when they are taken out and packed—a work which is generally done by two men who work in combination, the one selecting and the other packing and bundling. As a rule a Cuban selector will distinguish about ninety or more different color shades, although the smoker only knows of five, viz., *claro, colorado claro, colorado, colorado maduro,* and *maduro.* In fact these are the only terms which are marked on cigar boxes. The idea of separating the cigars into as many as ninety color shades is nothing but an ordinary business proposition. It guarantees an absolutely uniform bunch of cigars in the same box as to color, which is undoubtedly an effective way of catering to the whims of the most critical of smokers. These ninety colors, of course, are nothing but variations of the five principal colors.

The writter has been assured that the reason why the cigars are not boxed as soon as they are ready is that, as a rule, the tobacco bettle at least prefers to attack the cigars in the box. Whereas so long as the cigars are left in the large drawers, receiving some light therein now and then, the insect seems to show marked shyness about attacking the cigars. Is it possible that this particular insect prefers to perform its attacks in the dark as a habit?

As the demand requires and if the cigars are ready, they are packed right away and pressed in their boxes of cedar-wood (*Cedrela odorata,* Lin.), and in certain sizes are banded with paper rings, or, in the case of bundles, tied with ribbons. The boxes are then nailed and sealed at the edges with fancy strips of paper, the various labels put on and finally branded with the color mark which has been indicated above. They are now ready for shipment.

To conclude this article it is worth the while at least to make a few remarks regarding the boxes for the cigars. Tobacco quickly absorbs odors, and also moisture, by careless exposure to and contact with other odorous substances. The preference of the manufacturer for cedar-wood as the material for these boxes has a perfectly sound basis, and is amply justified by ex-

perience. The faint aroma of the wood blends pleasantly with the flavor of the tobacco without in the least neutralizing it as nearly all other odors do. Cedar-wood has only one defect and that is, it is porous. This defect, however, may be remedied by putting more cigars in a box. Boxes of 50's and 100's are convenient for the purpose. Another advantage of using this wood is that it is not so readily attacked by insects.

THE SUGAR CANE PROJECT OF THE BUREAU OF AGRICULTURE

By SILVESTRE ASUNCION, *Superintendent and In Charge, Sugar Cane Investigation*
and
MELQUIADES MEDINA, *Assistant in Agronomy, La Carlota Experiment Station*

The work of the Bureau of Agriculture on sugar cane dates back as far as 1903, and formerly consisted mainly of propagating sugar cane on a commercial basis. It was discontinued in 1907, but was resumed again in 1909.

In 1905 varieties of sugar cane were introduced from abroad with a view to finding some that would give better yields than those already grown here. The first shipment consisted of five varieties, as follows: White bamboo, Demerara 74, Singapore striped, Tiboo Mirid, and Lousiana purple. These were all secured from the Sugar Planters' Experiment Station in Hawaii. From time to time other varieties were imported, up to eighty in all. Those found to be unadaptable to local conditions were dropped. In like manner native varieties were also collected, tried and tested, and those that did not come up to standard, discarded.

The first plantings were made at La Carlota Experiment Station in Occidental Negros. Then when the scope of the work increased, other stations of the Bureau, Alabang, Lamao, and Singalong, took it up. At Alabang and Singalong stations variety tests were made of seedlings canes grown, and tested varieties propagated in coöperation with La Carlota Experiment Station, and Alabang conducted preliminary tests on sugar cane fertilizer also as detailed further on. The station at Lamao coöperated too from time to time, in the general propagation of tested varieties of sugar cane.

The Bureau of Agriculture has been distributing seed cane of the different tested varieties since 1904–1905. Reliable data give a total of 1,259,799 cane points as the number of distributed during the seven years between 1915 and 1921. The largest distribution was in 1920 and 1921 when 349,787 and 431,342 cane points were distributed respectively. The distribution in 1904–1905 was only 10,000 cane points.

The demonstration, extension, educational and coöperative work of this Bureau consists in the establishment of coöperative demonstration stations and plots in the sugar districts, both in the plantations and factories; in giving instructions as to the best cultural methods and sugar manufacture, and the routine

of plantation and factory management; in analysing samples submitted to the sugar laboratory by neighboring farmers to show them when to harvest their cane; investigating plantations and factories, with the aim of introducing the best possible methods; and, lately, in actively coöperating in the work of the Sugar Central Board.

The Bureau has published one manual (English and Spanish), one bulletin, 2 circulars, 20 articles in The Philippine Agricultural Review, and 42 articles in other sugar journals, all of which deal with sugar cane and the results of experiments thereon made by the Bureau. The most important among these publications is the book which is devoted entirely to cane production and sugar manufacture, by Cleve W. Hines, who used to be the Sugar Technologist of the Bureau of Agriculture.

Among the experiments performed during the past which have done much good are the variety tests, mill tests, soil investigations and survey, analyses of the different varieties, hybridization experiments and growing of seedling canes. The variety tests and the analyses of varieties have made possible the elimination of undesirable varieties; the mill tests have lead to the improved manufacture of sugar; soil investigation and survey have facilitated the establishment of sugar factories and the investment of money in the sugar business at profit; and the hybridization and growing seedling canes have made possible the production of many seedling varieties and the addition of a number of good varieties to those the Philippines already have.

In the variety tests the areas used vary according to the available facilities and supplies of cane points at the station. In all cases, the varieties are treated in the same manner as to culture; thus a comparative of results is always possible. Formerly, the analysis of the cane was not included in the procedure. The method used was only a study of the growth and general adaptability of the varieties as regards vigor, size, stooling, resistancy to diseases, and other important physical characteristic of each. Later, in 1913, analysis was included in the procedure thus making possible more accurate judgment of the merits of the different varieties. In analysis the following points are determined: weight of stalk; tonnage per hectare; per cent of extraction, content of sucrose, fiber and other compounds of the cane; and content of sucrose, glucose, non-sugars and coeficient of purity of the juices of the different varieties.

The following table of analysis of cane varieties from 1913–1915 at La Carlota Experiment Station shows the results obtained:

Cane variety	Average in 1913		Average in 1914		Average in 1915	
	Purity	Invert sugar	Purity	Invert sugar	Purity	Invert sugar
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Negros purple	88.6	1.15	85.39	1.667	88.44	0.458
Hawaii-309	79.5	2.04	83.72	1.441	87.27	0.408
Louisiana striped	86.3	1.51	93.64	1.392	87.28	0.482
Hawaii-27	81.3	1.69	80.71	1.523	85.64	0.415
Lahaina	88.9	1.28	87.06	0.765	91.72	0.315
Inalmon	88.0	2.03	86.60	1.226	88.14	0.406
Yellow Caledonia	78.9	1.97	80.64	1.420	81.41	0.547
Formosa	85.7	1.83	85.55	1.196	88.46	0.528
Tigbao mestiza	82.1	1.49	77.76	1.470	....	....
Hawaii-69	77.6	2.28	77.43	1.305	79.41	0.543
Rose bamboo	83.7	1.65	83.90	1.090	88.54	0.363
Hawaii-20	83.1	1.98	85.58	1.134	86.26	0.514
Hawaii-16	76.1	2.61	83.47	1.288	86.67	0.570
Hawaii-227	78.1	2.67	79.33	1.046	84.67	0.458
Luzon No. 1	91.3	1.96	84.94	0.795	88.61	0.323
Luzon No. 2	89.7	1.43	87.90	0.545	86.99	0.307
Luzon No. 3	83.8	1.95	87.34	0.603	86.86	0.503
Luzon No. 4	84.8	2.22	86.52	0.588	84.63	0.477
Japanese cane	....	....	85.01	0.689	83.74	....
Chinois 3526	....	....	84.01	0.669	83.74	0.213
Louisiana purple	....	....	84.01	0.670	76.54	0.487

A five-year record of the varieties grown at La Carlota Experiment Station (1916–1920) is given as follows:

Average analysis of cane juices from varieties of sugar cane grown at La Carlota Experiment Station (1916–1920)

Cane variety	Weight of stalk	Tonnage computed	Extraction	Brix	Sucrose	Purity	Invert sugar
NATIVE VARIETIES	*Kilos.*	*Per hectare*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Negros purple	0.63	40	87.0	16.7	14.2	86.4	0.81
Mindoro	0.63	32	67.2	17.6	18.8	86.5	0.95
Inalmon	0.58	35	61.3	16.7	14.3	83.3	0.88
Luzon No. 1	1.26	89	62.2	16.7	14.2	82.2	0.90
Luzon No. 2	1.04	84	63.7	15.7	13.2	83.8	0.87
Luzon No. 3	0.87	62	64.0	15.6	12.7	82.3	0.87
Luzon No. 4	0.87	69	62.7	15.6	12.9	82.1	0.88
Tigbao Mestiza	0.83	....	54.4	13.4	10.7	76.0	0.97
Cebu purple (a)	1.15	68	60.3	19.3	17.4	86.5	....
FOREIGN VARIETIES							
Badila	0.98	64	65.2	17.4	15.1	83.3	0.91
Yellow Caledonia	....	....	63.5	15.8	12.5	78.9	0.92
Guro or N. G.-24	0.60	38	65.4	16.8	14.4	85.7	0.90
New Guinea-24A	0.81	64	63.8	16.1	13.8	84.1	0.94
New Guinea-24B	0.98	41	65.1	16.0	13.4	82.9	0.95
Louisiana purple	0.99	57	63.3	18.2	15.9	89.2	0.83
Louisiana striped	0.78	39	64.0	17.6	14.9	85.7	0.84
3525-Big Tanna	1.46	59	63.5	15.3	11.7	76.8	0.89
Lahaina	0.63	35	64.8	16.9	14.6	84.8	0.87
Java-247	1.15	75	65.2	16.6	14.7	85.8	0.82
Hawaii-16	0.83	53	65.1	14.2	11.2	77.3	0.88
Hawaii-20	1.00	55	64.9	14.9	12.2	81.6	0.91
Hawaii-27	1.43	52	64.6	15.3	12.8	79.5	0.89
Hawaii-69	0.83	34	63.8	14.3	12.2	77.4	0.91
Hawaii-109 (a)	1.74	....	65.6	17.9	16.2	81.3	....
Hawaii-227	1.43	....	66.8	15.1	12.4	77.6	0.90
Hawaii-309	1.63	72	64.8	18.7	12.4	75.5	0.96
3536-Chinois	0.56	55	59.5	15.9	13.2	80.2	0.95
Otomato	....	....	63.7	15.1	12.4	73.2	0.96
Cheribon	0.85	34	64.4	13.9	10.2	73.6	1.04
Uba (forage)	0.54	63	59.2	16.5	14.0	81.7	0.86
Imperial striped, Cheribon	1.08	67	63.3	14.1	10.6	75.5	1.08
Malabar	1.77	72	63.0	15.4	12.1	76.9	1.03
Hambledon-426	1.11	57	63.5	17.2	14.9	86.0	1.01
Magalache	0.77	55	64.9	15.5	12.3	80.6	0.86
Formosa	1.33	87	63.9	16.3	13.7	83.8	0.88

During the year 1916 forty-one (41) varieties were grown at La Carlota to find out the yield of each variety in comparison with the native varieties. As a general rule the native varieties give a high percentage of sucrose and purity while the imported ones though heavy yielders are low in sucrose and give a juice with a low coefficient of purity. It is obvious therefore that the blending of these characters should make a superfine variety.

In 1917 the same experiments were carried on including ratooning. The stalk of the plant cane reached to a height from 2.3 to 4.35 meters and the number of stalks per hill was from 4 to 38. The stalk of the ratoons grew from 1.8 to 3.9 meters high and the number of stalks per hill was to 3 to 34. Analyses of these varieties showed that Formosa, H–20, Hambledon 5, Luzon 1, Luzon 3, Rose bamboo, Louisiana striped, Negros purple, and Lahaina contained a low percentage of fiber and the juice showed a high degree of purity while some varieties, like Imperial striped, Cheribon, Otomato, H–16, and Hambledon 426 though containing only a low percentage of fiber rated low as to purity of juice. For Badila, Inalmon, New Guinea 24A, Barbados, H–27, and Luzon 4 the percentage of fiber and degree of juice were both high.

In 1918 the variety tests plots were maintained in good condition. The canes on these plots attained a maximum size in October. These were analyzed in the laboratory.

In 1919 the condition of the plants in the ratoon and new plot of the variety test was not as good as in 1918, the plants not having grown as tall and sturdy as the year before. The probable causes of this poor condition were the severe drought during the early part of the year and the storm of October 14.

As a result of several years of study the foreign varieties which have been found best are: Hawaii–109, Hawaii–309, Hawaii seedlings Nos. 16, 20, and 227, Louisiana striped, Yellow Caledonia, Badila, Formosa, Java 247, and Cheribon, and among the native varieties, the Negros purple, Mindoro, Inalmon, Luzon Nos. 1, 2, 3 and 4, and Cebu purple.

The new variety test plots did well in 1921. Five varieties: H-16, H-27, H-109, Inalmon, and Badila were grown from seeds. The seeds were collected in the latter part of December of 1920, and were planted in deep seed plots January 6 and 7, 1921. They germinated January 13 to 15, 1921, and the young seedlings were transplanted in acclimatization plots on April 1, 1921. Due care was given throughout the period of growth.

Analysis of seedling canes during 1920–1921 milling season gave the following results:

Analyses of cane juices milling season, 1920–1921

(Seedling varieties)

Seedling cane	Extraction	Brix	Sucrose	Purity	Invert sugar
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
N. L.-13	68.6	17.4	15.2	87.0	....
P. I.-123	45.2	19.5	13.8	87.2	0.82
P. I.-135	66.4	18.3	14.7	80.8	1.74
P. I.-178	68.3	15.9	15.5	89.9	1.07
P. I.-227	64.3	17.8	14.7	80.8	1.34
P. I.-249	66.9	17.5	13.9	79.2	1.92
P. I.-290	65.8	18.5	19.2	86.2	1.43
P. I.-295	65.9	16.3	13.8	84.3	1.20
P. I.-303	67.6	17.3	14.5	83.3	1.99
P. I.-331	66.9	18.1	15.6	85.4	0.78
P. I.-335	64.0	16.5	14.6	88.1	1.11
P. I.-363	66.8	17.6	15.3	86.6	1.00
P. I.-371	64.6	16.6	14.6	81.3	1.15
P. I.-380	68.0	16.9	15.0	88.6	0.75
P. I.-391	61.9	14.1	15.5	88.9	1.06
P. I.-456	64.3	19.9	17.7	88.8	0.97
P. I.-460	68.6	15.5	15.3	83.1	0.88
P. I.-491	62.8	19.7	17.7	87.9	0.87
P. I.-512	70.2	19.2	17.6	91.9	0.88
P. I.-598	64.6	17.9	16.5	92.6	0.90
P. I.-751	68.5	20.3	17.4	86.1	0.94
P. I.-765	65.8	19.1	17.2	90.1	0.86
P. I.-787	66.1	18.8	16.7	88.9	1.16
P. I.-794	63.7	21.3	18.6	82.0	1.20

Several attempts were made to determine the value of fertilizers. Tankage, guano, and ready mixed fertilizers were tried. The fertilized plants with tankage at the rate of 560 kilos per hectare made a gain in growth of 1½ feet over the unfertilized. A guano fertilizer was used in Alabang in 1915. A sample analysis of this fertilizer by the Bureau of Science gave the following data: Nitrogen, 1.75 per cent; phosphorus, 21.45 per cent; potash, 0.94 per cent. The variety used was Hawaiian No. 20. The fertilizer was applied at the rate of 400 kilos per hectare. Little effect on the growth of the fertilized cone was noticed. Besides these, a fertilizer test was conducted in 1911 and another in 1920 at La Carlota Experiment Station. In neither fertilizer test was any beneficial effect on the fertilized cane noticed.

This work was started in the year 1920 on Negros purple. The fertilizers used were burnt and unburnt lime, bagasse ash, farm yard manure, filter press cake, copra meal, and bat guano. There were 4 check plots used. Observations were made on the general appearance of the plants, length of stalks, and internodes, diameter of the stalk, etc., planting was done on February 21 and 24, 1920, in twenty-three plots. Each plot occupied 201.6 square meters and was 42 meters long and 4.8 meters wide (4 rows at 1.2 meters apart). The harvesting was done from December 21, 1920, to January 13, 1921.

The following table gives the result and details of the 1920 experiment:

Plots	Actual yield per plot	Computed yield per hectare	Computed yield per hectare tons cane	Estimated value of crop per hectare at ₱8 per ton cane	Cost of production * per hectare	Net income
	Kilos.	*Kilos.*				
Check (1, 11, 20, 21)	856.9	42,504.9	₱42.50	₱340.00	₱106.04	₱233.96
Farm Yard manure (8, 9, 10)	944.2	46,853.0	46.85	374.80	131.56	243.24
Burnt-lime (2, 3, 4)	1,001.5	49,678.1	49.68	397.44	130.75	266.69
Bagasse ash (5, 6, 7)	1,072.5	53,199.4	53.20	425.60	133.67	291.93
Filter press cake (12, 13, 14)	816.8	40,515.9	40.52	324.16	125.75	198.41
Copra meal (15, 16, 18)	951.1	47,173.1	47.17	377.36	140.90	236.46
Calcium carbonate (17)	1,013.2	50,257.9	50.26	402.08	331.06	71.02
Bat Guano (19, 22, 23)	860.6	42,689.1	42.69	341.52	128.82	212.70

* Cost of fertilizer and application thereof included.

From the above table it is evident that all the plots except those fertilized with filter cakė showed an increase of production over the check plots, and that plots treated with bagasse ash, burnt lime, copra meal, and barn yard manure showed an actual gain compared with the check plots after deducting the cost of production together with the cost of the fertilizer and its application.

In 1921 an experiment was carried on using a mixed fertilizer. The rate of application was 500 kilos per hectare. The Bureau of Science report on the analysis of the mixed fertilizer was as follows: Moisture, 12.32 per cent; nitrogen, 3.35 per cent; phosphoric anhydride, 11.23 per cent; and potash, 4.43 per cent. The applications were made on May 19 and 24, 1921. On November 30, 1921, an observation was made on the stooling and it was found that there was a true average of 4.5 for the fertilized plots, and of 3.89 for the unfertilized plots. It was also observed that the cane on the fertilized plots arrowed earlier than did the unfertilized canes.

The following is the record of this test.

NEGROS PURPLE FERTILIZED WITH MIXED FERTILIZER

Total area used, 0.877 hectares. Date planted, March 19, 1921. Fertilizer applied, May 19 and 24, 1921. Date harvested, April 10 and 11, 1922.

ANALYSIS

	Cane		Juice					
	Sucrose	Fiber	Juice extraction	Average	Sucrose	Appa. Purity	Invert sugar	Acidity N/28 per cent
Check	12.87	7.27	64.7	19.47	15.7	80.6	1.13	15.5
Fertilized	13.85	7.69	65.5	19.87	16.9	80.0	1.23	25.3

YIELDS

	Age of cane when harvested	Actual yield of canes in tons	Computed yield of cane per hectare in tons	Actual yield of sucrose in tons	Computed yield of sucrose in tons	Result in piculs of sugar per ton of cane	Actual piculs of sugar produced	Computed piculs of sugar produced per hectare
Check	1 yr. 22	15.97	36.42	2.056	4.687	1.74	27.79	63.37
Fertilized	..do....	17.89	40.80	2.478	5.651	1.83	32.74	74.66

STOOLING

	True average	Mean	Average weight of one stalk
			Kilograms
Check	3.9	3	1.035
Fertilized	4.5	4	1.140

EXPENDITURES AND RETURNS

Item	Check	Fertilized
Actual expenditures per plot (0.4385 hectare)	₱46.50	₱82.32
Computed expenditure per hectare	106.04	187.79
Estimated value of the crop per hectare at ₱8 per ton of cane which crop is sold as cane	222.32	261.92
Net income per hectare when crop is sold as cane	116.28	74.13
Estimated value of return per hectare which is equivalent to 55 per cent of the crop when the crop is sold as centrifugal sugar at ₱10 per picul[1]	348.54	410.63
Net income per hectare when crop is sold as sugar	242.50	222.84

[1] Forty-five per cent of the crop is charged by Sugar Central in milling the cane.

Other work such as the study of diseases and pests and conducting defoliation experiments, was carried on in 1905. Only general observations were made of the occurrence of one or two diseases on a certain variety. Experiments were carried on in connection with cane attacked by locusts but were discontinued due to the lack of the materials. Analysis were made on cane attacked as well as of normal canes. From the results obtained no definite conclusions could be drawn. In 1920, Mr. Medalla made a careful study of the diseases of the different varieties and he found that Mosaic disease was prevalent among the different varieties. Another disease observed was the leaf spot. This disease was found on Cheribon and Demerara 1135. The disease did not affect the plants very much, since it caused only small dry spots on a few sugar cane leaves.

Irrigation experiments were tried at La Carlota Experiment Station in August, 1905. The report stated that the three irrigated plots gave better and quicker results than the unirrigated plots. In one instance the irrigated cane made a gain in growth of more than 2 feet over the unirrigated. Water applied in May

caused the root system to be stronger and larger; and, the linear and diameter growth increased proportionately.

The present work of the Bureau of Agriculture is largely along the same lines as in the past. New problems that promise to be of great interest are taken up from time to time. The experiments that are at present in progress are as follows: Variety tests, fertilizer experiments, effects of distance on planting, hybridization, point selection tests, and miscellaneous cultural experiments in ratoon canes.

Active coöperation is planned for the future among the Bureau of Agriculture, the College of Agriculture, Bureau of Science, Sugar Centrals Agency, and cane planters and sugar factories for fostering the sugar industry.

The writers express their thanks to Mr. Leoncio Dario, Agricultural Assistant, for help rendered in the preparation of this paper.

METHODS OF PLANT BREEDING IN GENERAL

*By NEMESIO MENDIOLA, B.S.A., M.S., Ph.D. *Consulting Plant Breeder, Bureau of Agriculture and Associate Professor of Agronomy, College of Agriculture, Los Baños*

Underlying improvement of different crops are some fundamental processes. These do not vary, essentially, when applied to individual kinds. Variation lies merely in details which are learned only through experience. Given a basic understanding of the essential phases of plan breeding, one should not find it hard to develop a method of improvement applicable to a particular kind of material.

METHODS CLASSIFIED

The various methods of plant amelioration may be classified under three main groups: namely, (1) selection, (2) hybridization, and (3) hybridization combined with selection.

(1) SELECTION

Too often, the term, "selection," as a method of improvement in Genetics, is confused with other processes to which selection is popularly applied. For example, it has been taken to mean varietal selection, that is, the choice and use of the best variety. Varietal selection within a species is indeed expedient especially when thousands of varieties exist. For the elimination of those varieties which are not profitable to raise will improve the average yield of the varieties or the species. However this does not fall under genetic selection. Neither does selection mean in cereal improvement the selection of the largest or the heaviest seeds although, again, it must be said that increased yield may be obtained by such a practice, for, in whatever way the biggest or the heaviest seeds be obtianed,—by hand picking or by the use of a fanning mill or by soaking the seeds in a brine solution where only the heaviest will not float, thus allowing their separation from the lighter ones—the seeds are freed from broken individuals and weed seeds. Weed seeds in the seed mean more expense in weeding and cultivation of the field, less moisture and food for the plants, and less yield and money for the farmer. Also, the larger and heavier seeds contain more stored food material for the embryo than the lighter and smaller ones, and under unfavorable conditions they are more likely to

survive. Except these advantages, it is very doubtful, as far as yield is concerned, if the large and heavy seeds have any superiority over the smaller and lighter ones.

It should be borne in mind that seed selection, as the term is used in Genetic literature, does not mean just selecting seeds, which are free from disease or other physical defects. True, the use of no seeds but those disease-free, is to be preached, indeed this must be the practice on every farm, for it may happen that the disease on the seed will appear on the plant which grows therefrom. This would mean a diseased field which means poor yield and a loss to the farmer. But even when only the best variety is grown, and only seeds which are free from broken grains, from weeds seeds and, from diseases are used, there remains the fact that the yield may be poor, unless genetic selection, or strain selection is practiced.

The reader doubtless knows the meaning of the sayings, "it is the blood that counts," and "one is of bad ancestry." We can just as truly say, "It is performance that counts." When we desire to improve a given variety of plant by improving its yield through selection, what is really desired is to free a given stock from such blood, or strains as is responsible for low yield, and to obtain only plants that are high and superior yielders. But it is usually impossible to tell from the appearance or from the size or weight of a seed whether the plant which it will produce will be a poor yielder or a heavy yielder. In a given number of seeds from unselected plants, a plant from a large seed may actually yield less than a plant from a smaller seed. The appearance of a seed should serve only sometimes as a guide in the selection of initial parent plants. The appearance of the plant does not always tell what kind of yield its progeny will give. Under certain circumstances, such as when a plant has more fruits than another because of more favorable soil conditions, the progeny of this more favored plant, on account of less fertile soil, may actually yield less than that of the poorer looking individual. Since neither the appearance nor weight of a seed nor of the plant will tell us exactly what kind of yield the progeny will give, the final judgment of the yielding power must be based on the ancestry of the seed or plant or on the plant's performance—on what it actually does. An example may make this point clear. Suppose, to improve the Filipino race it is desired to enact immigration laws that will prevent the entrance of feeble-minded strains into this country. These laws will prevent admission of immigrants which are feeble-minded,

assuming that in this way the "blood" which carries feeble-mindedness will be excluded. But this assumption will not always hold good for even if one be not feeble-minded, he may be a carrier of defective germplasm which bears the determiners for feeble-mindedness and, if allowed to reproducé, may in time be the parent of feeble-minded children. The prevention, therefore, of the entrance of feeble-minded "blood" into the Islands could not depend only upon the appearance of the incoming immigrant but also on his ancestry, just as the hereditary yielding capacity of a grain or seed is best judged from the performance of its parent plant. In brief, then, proper selection is to be based not on appearance alone, but, on performance also. This being true, to get any maximum improvement of the yield of a variety, ultimately consists in the isolation of the *best single* strain in that variety.

Selection may be of different kinds: (*a*) mass selection, (*b*) line selection, (*c*) clonal selection, and (*d*) bud selection.

(*a*) In *mass selection* we proceed somewhat as follows: Bearing in mind the object of the selection, individuals are selected on the basis of this object and then are planted in a mass. Selection must be made intelligently, in the manner and at such time as will insure the best results. Oftentimes, this can not be done except in the field when the crop is mature. We may illustrate this with corn. If the object of selection is to improve the yield, intelligent selection of seed ears is not made in the pile, for here we have no way of knowing which ears come from high yielding strains and which come from the inferior sorts. Sometimes superficial examination is sufficient to enable one to choose the desirable individuals. Sometimes, however, different methods of analysis are employed to decide which plants are to be selected and which are to be discarded. Chemical and other analyses are used; also the scale and balance; and the performance record is kept for several years.

For mass selection to be of the greatest value it must be continuous until the limit of improvement is reached. For purposes of demonstration or to determine if any progress and how much is being made, it is necessary to plant a check side by side with selection. The check consists of a portion of the original material. The material left after selection does not serve as a proper check, neither does a portion of the material from which the inferior strains have been taken away, constitute a proper check.

In the absence of check cultures, the progress of selection may be determined by comparing the performance of the selected

crop with the average performance of the variety for five or more years in the locality or region. When one is familiar with his crop and soil, it may be possible for him to tell when he is getting any improvement even if either the direct or the indirect check for comparison is lacking. However, this is true only under average conditions. If for any reason the crops suffer from unfavorable conditions and becomes abnormal, then it will be difficult, if not impossible, to diagnose progress.

When check cultures are run at the same time as the selection tests, one point should be borne in mind, and that is genetic contamination. The selected plantings should not be allowed to cross with the check or with any other material. For this reason it is advisable to carry out the selection cultures in an isolated field and to screen them from the check by planting border plants several rows deep. These plants may be of the selection itself, in which case they should be discarded after harvest, or they may belong to another but faster growing species. Whatever is used, the screen must be effective. With tobacco, contamination is prevented by producing the seeds under bags.

When the plant is self-fertilizing and is not subject to any amount of crossbreeding, the precautions given above are unnecessary.

It should be emphasized here that in selection, the individual plant is the unit. This point is likely to be overlooked under certain circumstances. For instance, when several seeds of a crop are planted in a hill, the hill is sometimes taken as the unit. It is evident that, in so doing, the choice of individuals becomes a hit-or-miss affair. This is well illustrated and discussed fully under mass selection in rice.

The improvement in mass selection is obtained slowly and in this respect it is inferior to line selection. It has the advantage, however, of being practically nontechnical and hence easy to use. Mass selection has been used with cotton, and with rice, corn, and other cereals.

(*b*) *Line selection* consists in the testing of the progeny of single individual plant. Le Couteur and Shirreif were the first to use this method. The progeny test was specially used by Louis Vilmorin and line selection is sometimes called the "Vilmorin Method."

The initial selection of plants in line selection does not differ at all from that of mass selection. Generally, however, fewer individuals are selected in line selection. The critical difference between the two methods is that in line selection the progeny of each selected parent plant is tested separately. The

method of planting is often termed "head-to-the-row," "plant-to-the-row," or "ear-to-the-row," meaning that the seeds from one single head, plant, or ear are planted in one row. Not all the seeds from one plant need be planted, only sufficient to give a fair sample. One hundred offspring are generally sufficient to represent the strain. When about 100 seeds are sown in a row, the method of planting is termed "cent-gener method." This was first used by Hays of Minnesota in grain breeding.

Each year, the most promising lines or strains are saved and tested. This is done until the few really superior sorts are discovered, or the best single sort, then the seeds of each line may be multiplied as fast as possible and introduced into the seed trade or into the general farming. The critical point in line selection is the isolation of the best single strain. It were better if we called the process, isolation. Strictly speaking, no further selection is necessary if the isolation is done properly. Of course care must be taken that no seed of inferior race contaminates the improved stock.

Line selection has been the important method of plant improvement followed in the Sweddish Seed Station at Svalof. Here the method came to be known as the "System Pedigree" or "Separate Culture."

Line selection is easily applicable to naturally self-fertilized plants or to those reproducing vegetatively. Among them there is practically no out-breeding. When applied to naturally cross-fertilized plants, selected parent plants should be guarded and prevented from crossing with any other plant in the same row or in another row. Either mechanical or genetic contamination by inferior strains will cause a gradual loss of improvement in proportion as the seeds of inferior quality supplant the improved ones. Moreover, the selected plants should be self-pollinated.

(*c*) *Clonal selection.*—The term "clon," from which the adjective "clonal" is derived, is applied to a pure line produced asexually. We may conceive of a population consisting of a mixture of different clons (sometimes written "clones"). Improvement in this kind of population will be obtained by isolation or selection of the best clons or the best one of them. Within a clon itself, as within a sexually produced pure line, heritable and desirable variations may arise and selection within this pure line will have for its object the isolation of those variations.

Common examples of clons are found in fields of potatoes, of abaca (*Musa textiles* Nee), of plant canes (distinguished from seedling canes), of ordinary plantings of cassava and pineapple.

(*d*) *Bud selection* is closely related to clonal selection. Bud selection has been used mainly in fruit improvement. It is generally known that bud mutations or bud sports occur in fruit trees. Many important commercial varieties of fruit existing at the present day originated as bud sports. The Washington navel orange is a familiar example.

In the Philippines, bud selection has a promising future. We practically have no seedless variety of any pomological crop. We are looking ahead to the day when one may eat the delicious lanzon without having to be bothered with its bitter seed. We anticipate similar improvement with mango, mabolo, and other fruits. Bureau of Agriculture officials verbally claim that there is now a seedless *duhat* (*Eugenia jambolana* Lam.) variety which is in the way of propagation.

(2) HYBRIDIZATION

Objects.—Hybridization is performed with one of three main objects in view. These objects are: (*a*) To bring about increased variability, that is, to "break the type;" (*b*) to get a combination of certain desirable characters; and (*c*) to obtain increased vigor which is supposed to be due to heterosis, or the heterozygosity of the hybrids.

Aspects.—When the object of hybridization is to test or further study any or all of the phases of the Mendalian laws of heredity or to obtain hybrids from parents of known purity it is a purely scientific aspect. In this kind of work control of parentage is important. Because the operation is quite technical and consumes a good deal of time, it cannot be done on a commercial scale.

Hybridization has also been performed for a purely commercial or utilitarian reason and without strict adherence to scientific precedents and procedures. The work of Burbank, of which more will be said later, as well as the work of horticulturists, are good examples of this phase of hybridization. For convenience, I will designate this kind of work as commercial hybridization.

Technique of hybridization (*purely scientific*).—A prerequisite for this work is familiarity with the sexual group of plants and the pollination habits of the flowers.

Generally, plants may be classed under three groups: (*a*) Diœcious, (*b*) monœcious, and (*c*) hermaphrodite. In diœcious plants, one sex is in one individual while the opposite sex is in another. It has become a custom to call the plant carrying the male sex, a male plant; and the female sex, a female plant. We

have, for example, a male *papaya* (*Carica papaya* L.) tree and a female *papaya* tree. If a plant carries both sexes and if one sex is not functional or functions at a different time than the other, it is for all practical purpose, a one-sexed individual. We find an example of the first case in *papaya* also, and of the second in *Musa textiles.* (*b*) In the monœcious group both sexes are in the same individual but in different parts of the plant. Corn and cucumbers are good examples of monœcious plants. (*c*) When a plant possesses both the male and female sex organs in the same flower and when both sexes are functional, it is said to be hermaphroditic plant or to be a hermaprodite. Many of the cultivated crops belong to this group.

Besides a knowledge of the groups described above, a hybridizer must know a number of other points about the flower. These are: (1) Structure, (2) relative time of maturity of stamens and pistilis, (3) the quantity of pollen necessary for a good setting of seeds, (4) the length of time at which the pollen remains viable, (5) the amount of injury the female flower will stand, (6) whether the flower is self-fertilizing exclusively or whether it admits of a certain amount of cross-fertilization, (7) conditions of the pistil when fully ripe or receptive of pollen, (8) approximate length of time from pollination to fertilization, (9) the relative position of male and female flowers in the same tree, or of the male and female parts in the same flower (whether the anther is above the pistil so that the pollen drops naturally upon the stigma or whether it is below, necessitating some pollinating agent), (10) the number of anthers, (11) manner and time of dehiscence of pollen, etc. Some of these points may be learned before starting hybridizing work, while others are found out only through experience.

It should be emphasized that, in careful hybridization work, the essential thing is to control parentage absolutely. Hybridization may be further explained by giving specific procedure with different groups of plants.

With diœcious plants, there is selected one plant for female and one for male. Certain buds of these plants are selected and bagged. It is preferable that these buds should be of the same age. The reason for bagging the buds is to protect them from foreign pollen. For most accurate work, it is always necessary to bag the male flowers as there is always the chance of insects visiting the flowers after they have been on other flowers. This is not imagination; in very careful bagging work contamination of pollen has been known. With monœcious plants the male and female clusters are bagged separately.

With perfect flowers, that is, with hermaphroditic flowers, the procedure is somewhat different. Here, emasculation, that is, the removal of male parts to render the flower essentially female, is practiced. Emasculation must be done sometime before the pollen matures, that is, during the bud stage. After deciding on the parent plants that are to be used, a few buds are picked out on the female plant. All other buds and flowers likely to be included by the bag are removed. Even a single bud left in the same bag with the emasculated flower may spoil the work, as the pollen from the non-emasculated flower is almost sure to come out and settle on the stigma of the emasculated one. With a pair of small forceps, the floral envelope is cut off on one side. In some cases the top portion may be cut off or even the whole perianth may be removed without causing injury to the flower. In fact, it is advisable in some cases to remove the whole corolla. However, some flowers are so sensitive that any great injury done them will prevent the setting of seeds. Experience alone will tell what flowers are this sensitive and what flowers are not. After cutting the floral envelop either in part or in whole, the forceps are thrust into the flower and *every single anther is removed. Every single anther must be removed* for, if any anther is left, it will produce pollen, a condition to be avoided. It is not advisable in this process of removal of anthers to hold the anthers themselves, for in doing so there is always a possibility of breaking the pollen sac, and when this takes place, some pollen grains may drop and later mature. As soon as all anthers are removed, there remains essentially a female flower, but at this stage, it is not yet ready for pollination. So it is bagged and left for three or four days, even a week, for the stigma to develop to the proper age. The flower is tagged. On the tag some symbols are written which will show the date of emasculation and what treatment is to be given, and about when it will receive this treatment. The tag may include with what parent plant it will have to be crossed. For bags there are used small bags which will remain waterproof for several days.

At the same time that the female flower is bagged the male plant is selected and some buds are bagged without previous emasculation. As with the female flower all other flowers are removed as these may have some foreign pollen brought to them.

The length of time from pollination to fertilization depends on the condition of the bud and the weather conditions. Cloudy days delay pollination while bright days hasten it. At least 24 hours are usually needed.

When the male and female parts are ready for pollination can be told by their color. They usually become darker, also viscid and sticky due to secretion of different sugar solutions by the cells. When they are ready the male parts are brought to the female; the bag of the female is removed very carefully and the pollen is rubbed on the stigma.

Some plant breeders make it a practice to use a watch glass for holding pollen and a camel's-hair brush for transferring pollen from the glass to the stigma. These helps may be all right if only one kind of pollen is to be used; if several kinds are used, the glass and brush may be sterilized by dipping them in alcohol. But the risk lies in the sterilization not always being thorough.

After pollination, the female new pollinated flowers is re-bagged and a record is then taken. The flowers are left bagged until danger from contamination is over.

If fertilization takes place can be told from the discoloration of style and stigma. When the stigma has wilted, the bag may be removed and after this, the rest of the work is simply taking care of the fruit or seeds until they are ready to harvest. If the flowers are of such a nature that there is danger of losing the seeds by bursting, the flowers or ovaries are kept in a kind of a cage.

After harvesting, the seeds are taken good care of in drying and storage.

When thsee seeds are planted, the resulting plants are the F_1 plants. At the same time the seeds are planted some parent plants are self-pollinated and plants grown from the self-pollinated seeds for comparison. If the offspring of the self-pollinated parents show great variability, the F_1 plants are to be discarded.

It is a good plan to make back crosses of both parents,—that is, to use pollen of each and pollinate flowers of the F_1 plants. The bulk of seeds F_2 will come from self-fertilized F_1. Sometimes, plants have flowers which are self-fertile. In other cases artificial pollination is necessary.

Records.—Keeping records is so important that some plant breeders spend more time in record keeping than in actual handling of the plants. The following points should be recorded not only on the tag or label left with the plant but also in the record book: Date of emasculation; the number or designation of the male parent; and the date of pollination. In the record book should appear, also, a record of the male and female parents and a description of such characters as are involved in the study.

The hybridizer's working outfit.—For general purposes the tools herein named are needed. A small good-powered hand lens to use in examination of small floral parts and small pair of scissors with slightly bent blades about two and one-half centimeters long. For very small flowers, a small pair of surgeon's scissors with blades about one centimeter long is very convenient. Forceps are useful in removing petals and anthers. Small containers for pollen and some moist chamber for keeping pollen in a moist condition should form part of the outfit. Small-sized merchandise tags and small-sized camel's-hair brushes may be added.

The nature and pollinating habits of the flowers oftentimes determine the special tools to be used. There are flowers such as of the alfalfa, which are bound to be pollinated while handling them. The emasculation of this type of flowers has caused some plant breeders to devise special tools for the process. Information along this line is well given by Oliver (1910) of the United States Department of Agriculture.

The choice of material for bagging entire plants is sometimes a problem to the breeder, and the following suggestions by the Howards (1920) may be useful. They claim that when they got their best results they used cylindrical muslin covers in the Botanical area at Pusa. The covers were on frames consisting of three bamboo rings. For most purposes the cylinders need not exceed a length of 75 centimeters and a diameter of 30 centimeters; the size may be varied according to the object to be bagged. An advantage claimed for this kind of cover is that it allows a greater percentage of setting. The muslin covers are easily washed after use and they last for two seasons. It is said, also, that no cases of cross-fertilization have been detected through their use.

The preservation of the viability of pollen is another problem which is met with when the pollen has to be shipped a long distance, as from one country to another. The viability of grapefruit and tangelo pollen has been preserved for six weeks after the pollen grains were gathered, permitting them to be sent from Florida to Japan. The method used in this drying was reported by Miss Kellerman (1915) as follows:

> * * * Anthers in dried vacuum glass tubes, i. e., tube filled with 1–2 inches, cotton ½ inch, exhausted to about 0.5 mm. pressure in the presence of sulfuric acid, the tube then sealed. As far as practicable the pollen was kept at a temperature of 10° C. Until sealed.

Commercial hybridization.—The best example of this work is that of Luther Burbank of California whom some people call a

"plant wizard," a name which Burbank, however, regrets being applied to him.

The life and the work of this wonderful worker is described by Harwood (1919) in a book.

The following quotations from this book will give a very helpful idea of the method with which Burbank has been able to accomplish his very well known work:

Instead of one or two experiments underway at the same time, he may have five hundred at once, all requiring constant supervision, many of them extending over a period of perhaps ten years before they come to fruition. Instead of having a few square feet of ground or a few pots under glass, he uses acres of ground, if necessary, in a single test. In place of contenting himself with a half dozen, or even fifty plants, in making a given test, he uses if necessary a million, all of them pressing forward in a million similar ways, toward the same end. And out of the million he saves perhaps in the last sifting but one, and that one the best of all.

* * * He is confined to no one species nor to any one line of combinations. The whole world is his field, and he makes his selections and forms his combinations in absolute disregard of all precedent. The end in view is the point, how to reach it most directly. It may be along so-called scientific lines, it may be in absolutely new and original paths,—more likely the latter,—but the means are the non-essentials, the end is paramount.

Hardwood quotes the following advice and warning from Burbank:

The plant-breeder, before making combinations, should with great care select the individual plants which seem best adapted to his purpose, as by this course many years of experiment and much needless expense will be avoided.

Quoting Hardwood again:

But Mr. Burbank does not recommend any difficult problems for the amateur; rather, he insists on the very simplest ones to begin with. He places confidence, the confidence which comes from having accomplished something, as the initial essential * * *.

And to this end he urges taking up a single flower to begin with, never a composite one.

When a certain flower * * * has been decided on, the pollen from one of the two that are going to be crossed in order to give birth to a third that, it is hoped, shall be better than either parent, is gathered upon a little saucer or a watch-crystal, taken to the flower which has been chosen as mate, and dusted down upon its stigma. Then this little flower should be isolated from its fellows and guarded carefully. A paper tag should be fastened to it for identification. Mr. Burbank says to watch the bees, and when they are first a-wing upon their day's work, be sure the flowers are ready to be pollinated.

He says it is wholly unnecessary in ordinary plant-breeding to attempt to cover the flower with a screen of tissue paper or gauze. This method has been followed by some in the belief that they were thereby preventing

insects from coming in and destroying the pollinating, but he holds that, save in some particular cases, the act is not only absurd but absolutely harmful and more than likely to injure the flower by keeping light and air away from it as to frustate the very end aimed at. If the pollinating has been thorough, nature may safely be left to do the rest.

Great care also should be exercised in saving the seeds of the plants under test. He recommends air-tight glass jars for the purpose. The jars should be kept in some secure place—it is beyond the power of any mind to say how precious these seeds may prove to be.

From the plants that grow from the new seeds only one should be chosen, the very best of all, the one which is the thriftiest, the best bearing, the nearest to the ideal. The seeds from this one plant should be in turn planted, and them from a very few of the very best plants enough plants saved out to insure a somewhat larger crop for the next generation. Then from this larger generation only the very best one should be saved. Mr. Burbank lays special stress upon this,—to save only one and that the very best of all; no matter if there be hundred plants or a thousand, save only the very best * * *.

According to Hardwood, Burbank's success in being able to judge his plant accurately and pick out the best individual from hundreds and thousands depends on his intuition.

For an amateur, Burbank suggests an outfit consisting of a pair of jeweler's forceps or pincers, a jeweler's eyeglass, a small but powerful microscope, a sharp knife, a saucer for holding the pollen, a soft brush for sifting or dusting the pollen from the saucer to the stigma of the plant to be fertilized. It appears that Burbank himself makes use of any or all of these, sometimes those devised by himself, but chiefly he performs hybridization by securing the pollen upon a watch-crystal and placing it upon the stigma with his finger-tips.

(3) HYBRIDIZATION COMBINED WITH SELECTION

After a hybrid population is obtained, the next step in improvement consists in the isolation or selection of the best hybrid individual. A hybrid population may often consist of different genotypes and phenotypes. The selection of the best strains may be made either by natural selection or by artificial selection.

In artificial selection results may more quickly be obtained by using line selection. The test of the progeny of each hybrid parent will show at once which parent produces segregation. If the selection be for homozygous individual with respect to a certain character, any test row showing heterozygozity may be eliminated immediately. From the rows which are saved, a number of plants are to be selfed and guarded to prevent crossing with the other plants. Repeated line tests will ultimately reveal the line desired. In vegetatively propagated crops, if a desirable hybrid plant is once obtained, "fixation" of desirable characters

is accomplished immediately as it is only necessary to propagate the plant by cuttings, buds or other vegetative parts. Segregation is, at once, prevented this way.

The selection of desirable lines in a population may be left to nature. An example of this practice is found in the work of the Svalof Station. In Newman's (1912) book, we read: "Still another course of procedure in crossing work, especially with autumn wheat, has begun to be practiced at Svalof, viz., *the creating of populations.* Two known sorts are crossed and the whole progeny from all second and succeeding generations is sown together *en masse.* The object of this plant is to allow the severe conditions of winter and early spring to either destroy or expose the weakness of as many of the more delicate combinations as possible. In the latter case the breeder is given an opportunity of assisting nature in her work of elimination by practising a form of mass selection. While there is thus effected in a very simple manner, a gradual weeding out of a great mass of unfit combinations, the progeny of a crossing at the time gradually assumes the character of an ordinary mixed population, the different combinations becoming automatically constant as time passes."

What may be hybridized.—This is a question that always assails the curiosity of would-be plant breeders. The tendency of amateur hybridists is to attempt crossing widely related forms. Will mango cross with the lanzon and what kind of a looking fruit will be obtained from the work, is the type of question quite often asked. Compatibility between two individual plants is indicated, it would seem, by their systematic position. Crosses between families are unknown. Between genera there are only a few cases. We have the teosinte-maize cross. Several foreign cases of this are known. We have a case of a natural cross between these two plants in the College of Agriculture. In 1918 one-half of a trial plot in this College was planted to teosinte and the other half to maize, *Zea maiz indurata* Stur. The corn variety was Blanco Quarentano introduced into the College through Doctor Weston, of the United States Department of Agriculture. Seeds were harvested from the maize culture and planted. Out of 43 plants produced, 40 were somewhat intermediate in appearance between corn and teosinte. The other three plants looked like normal corn plants, except that they did not produce any ear. Likewise from teosinte seeds, hybrids were produced. Teosinte's specific name is *Euchlaena mexicana* Schrad. Collins and Kempton (1920) reported that in Mexico both teosinte and maize frequently show contamination. They also reported an

artificial cross which they made between Florida teosinte and the Tom Thumb pop corn. Another example of inter-generic cross is a hybrid between radish (*Raphanus sativus* L.) and cabbage (*Brassica oleracea* L.). Gravatt (1914) who reported the case declared that the radish was characterized by a great amount of vigor which was evident from the illustration. However, the hybrid was absolutely sterile.

In species hybrids, a very much greater number of cases are found than in inter-generic crosses. Collins (1917) crossed *Zea ramosa* and *Zea tunicata* and found that these species behave in a Mendelian fashion.

In 1908, Wester (1915) crossed sugar apple (*Annona squamosa*) and cherimoya (*Annona cherimolia*). It is said that the hybrid plants "greatly surpass the parents in vigor, and are very similar in habit, stems, leaves, and flowers to the cherimoya."

Babcock and Clausen (1918) cite crosses between *Antirrhinum molle* and *A. majus; Nicotiana alata* and *N. langsdorffii; N. alata* and *N. sanderae; N. langsdorffii* and *N. sanderae; N. rustica* and *N. paniculata; N. paniculata* and *N. langsdorffii; N. suaveolens* and *N. macrophylla; N. sylvestris* and *N. tabacum; Digitalis purpurea* and *D. lutea* and between *Oenothera biennis* and *O. muricata.* It is declared that while many of the first generation hybrids in species crosses are more vigorous than either parent, others are exceedingly weak.

COMMERCIALIZATION OF IMPROVED SEEDS

The method of introduction of an improved sort of seeds into general agriculture is something that demands serious study and consideration on the part of plant-breeding students. The value of improved seeds lasts as long as their purity is maintained. Once this is impaired, once contamination by inferior material takes place, a gradual "running out" or diminution of its value may be expected.

Experience in the United States has shown that ordinary farmers can not very well be relied upon to multiply and guard selected seeds from contamination or other unfavorable effects. Hence, the Government does most of the multiplication work. When the United States Department of Agriculture has a newly introduced variety for trial, it is generally sent to different state experiment stations or agricultural colleges where it is tested and, if found desirable, multiplied or sub-tested if necessary, in different counties and introduced into general farming. When farmers have to do the multiplication work, it appears that it is necesary to establish a system of supervision and inspection

under which technical men can see that the work is done properly. Where the farmers have had training in technical agriculture, such as those who are graduates of agricultural colleges or who have taken short courses in these institutions, the supervision system is not always necessary.

Probably an ideal agency for the commercialization of improved seeds consists in a seed growers association which may be placed in charge of the commercialization of the improved seeds that the Government isolates. In this association the members are either plant breeders, themselves, or those who understand the principles of technical breeding. Each member has a plot in which he grows his seeds. He himself sees that impurities do not enter into the material from planting to the time it is sold. The association certifies to the purity of the seeds when these are sent to the market. This method is similar to that followed successfully in Canada by the Canadian Seed Growers Associations and in Europe by the Swedish Seed Associations. These associations are subsidized by their respective governments.

The Tropics have not yet reached the stage when seed growing is a common business and when the seed growers are particular about their seeds. Undoubtedly, the time will come when as a result of agricultural evolution, the method found so successful in Europe and the United States will be adopted in the Tropics.

Meanwhile, improved seeds are generally distributed in small amounts direct to the common farmers who are left to multiply them, the Goverment purchasing the greater part of the harvest for another and wider distribution. In the Philippines especially, this has to be done in response to insistent public demand for proofs of what the Government accomplishes in the way of agricultural improvement. Such a procedure is unscientific and wasteful for the seeds soon become impure before they could benefit a greater number of growers. The Government, perforce, allows the people to profit from the results of technical work rather prematurely. It is believed that, in the long run, better results would be obtained and economy effected, if the seed institutions of the Government were made to handle improved seeds until sufficient amount was available for a very much greater and more general distribution. This should be done until the work is taken up by some seed association that can handle it properly.

The following account by the Howards (1912) of a system of seed distribution to cultivators in India is of interest:

> Among the successful schemes of seed distribution in Madras the replacement of the mixed crop by a pure Karungani cotton in the Tinnevelly District is a notable achievement. This variety, originally found in a pure cotton tract, was tested on the Koilpatti Farm and proved to be a great advance on the local mixture. A system of seed distribution was then gradually built up, and, at the present time, after five years' work, there are 80,000 acres of this cotton in the district. The agricultural farm grows sufficient cotton to supply the contract seed growers and buys the unginned seed from these men, gins it and arranges the distribution of the seed to the village depots before the sowing season. Each depot supplies two or three villages and a suitable man is selected as the depot keeper who retails the seed under departmental supervision at a fixed rate and on a commission of annas four per bag. The village is regarded as the unit and every effort is made to get all the growers in each village to take up the seed. It is important to notice that the procedure follows that of the best seed growers in Europe and that the seed grown by the contractors is under strict control and comes back to the department every year.
>
> In the Central Provinces, equally striking examples are furnished by the Agricultural Department. In the cotton tracts the work of seed distribution is confined to two suitable kinds, and a fairly large supply of seed is produced on the Government farms which is distributed to private seed growers who themselves retail their seed to the cultivators. In the wheat-growing tracts of this province, the efforts of the department are concerned with distributing a pure soft white wheat to selected *malguzars* who are members of the District Agricultural Associations. Each man agrees to sow a large area and to provide suitable arrangements for storing the seed and threshing the crop. In this way it is expected that beginning from a central farm a gradually increasing area of the wheat tract will be sown with one wheat only to the great advantage of the growers and the trade.
>
> The main features of the above examples are that seed distribution starts from a central farm and gradually spreads outwards. The assistance of the best farmers is enlisted, the seed is fully charged for and the work is conducted in tracts where markets already exist for the produce.

SOME NOTES ON RICE HYBRIDIZATION WORK

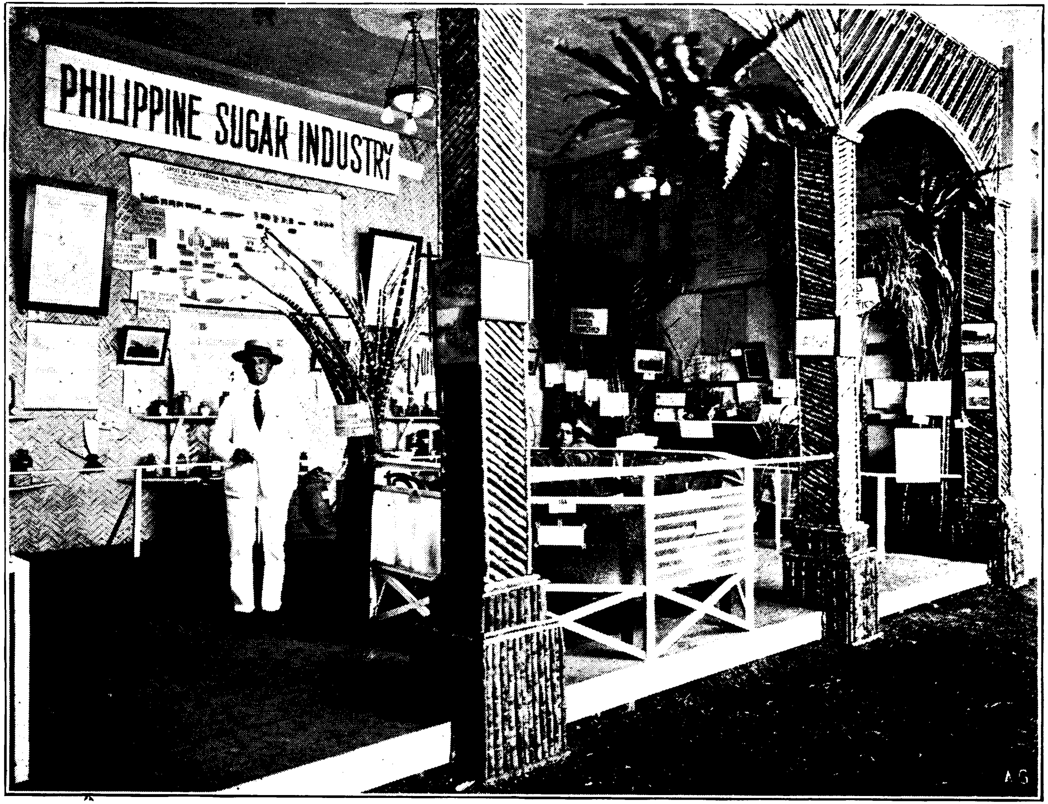
By J. P. Torres, *of the Alabang Rice Station*

With rice as with other crops in general, the principal object of hybridization is to combine desirable characters or to eliminate undesirable qualities. For example, by crossing a variety which is a heavy yielder with rather small grain with a variety possessing a larger grain, there might come out a more productive type having a good sized grain. Of course, greater prolificacy as a completely dominant character is to be desired. Again, if a variety having good flavor is crossed with another which is very productive but does not taste so good, a variety of high yielding capacity and good flavor might be obtained ultimately.

METHOD OF HYBRIDIZING

It is necessary to note down all varietal characters of the present plants. Two important things should be determined: (*a*) the characters of each parent plant whose combination is desired and (*b*) the qualities to be eliminated from them.

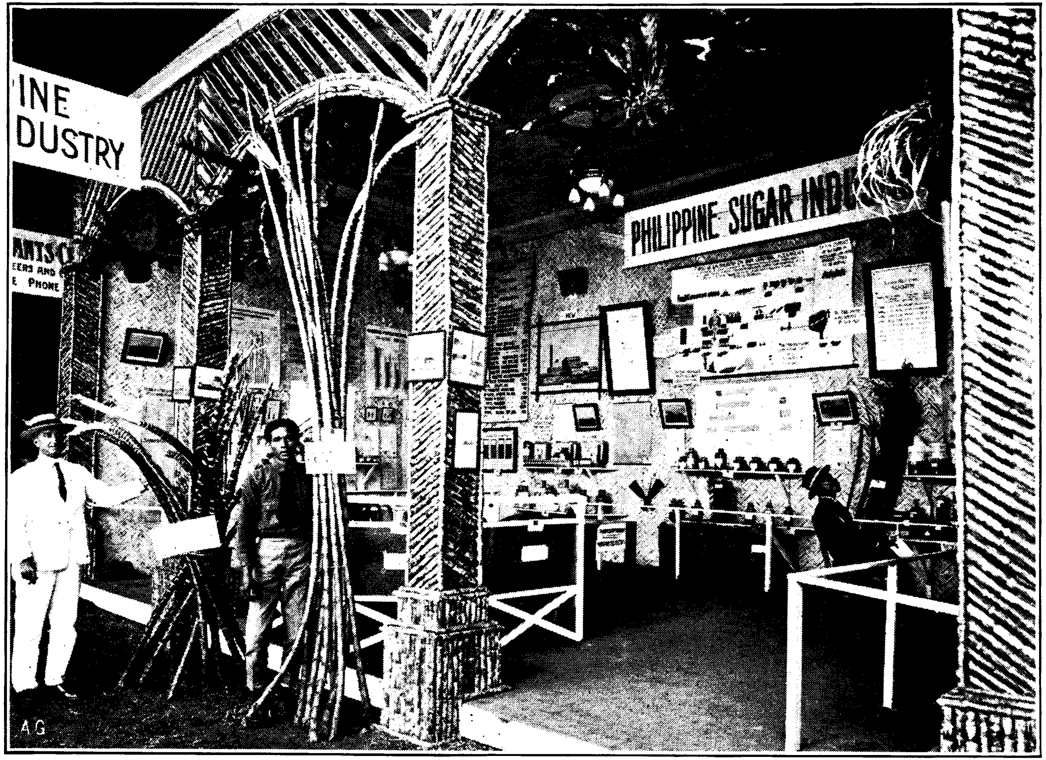
When to emasculate.—Emasculation must be done some time before the pollen matures. It must be understood that the rice flowers open up after several hours of exposure to sunlight Generally the flowers open between 9 a. m. and 11.30 a. m. on bright sunny day. Each flower opens its flowering glumes just once. At times, but very rarely, a few rice flowers will open when the sun peeps out in the afternoon of a cloudy day. Flowers which emerge from their sheaths one day are sure to open up the following day, provided this is sunny. This is especially true with non-bearded varieties. With bearded types of rice, there are cases in which the flowers open within three days from the time they emerge from the sheath. The opening of the flower is a sure sign of the maturity of pollen grains and the receptive stage of the stigma. Emasculation must be done in the afternoon, because in the morning, when the sun shines brightly, the pollen sacks are very sensitive to the touch and will suddenly discharge the pollen grains. In the afternoon also, there is practically no chance of pollen grains flying about in the air and settling on the stigma of the flowers being emasculated.



Courtesy of *Sugar News*

A view of the sugar booth at the Carnival Industrial Exhibition

The exhibit at the booth consisted of standard native cane varieties; seedlings; promising foreign varieties; diseases of sugar cane displayed in preserved specimens; insect pests; illustrations, charts, graphs and publications on sugar; and jars containing samples of the various juices and sugars manufactured in the Philippines.



Another view of the sugar booth. Courtesy of *Sugar News*

How to emasculate.—The flowering glumes are cut off crosswise with a pair of sharp scissors. With a pair of very small forceps all the anthers in the flower are removed. Care being taken not to break the pollen sacks. A single pollen grain which may remain in the flower operated upon is liable to cause fertilization. The larger end of a needle No. 2 may be used for removing the anthers. The emasculated flowers are enclosed in light paper sack which is water proof for several days. The number of flowers to be emasculated in a panicle depends upon the breeder.

Gathering pollen grains.—The flowers from which to get pollen should be bagged before they and other plants in the same plat open their flowers so there will be no contamination with pollen grains from other plants. The pollen should be gathered in the morning, as the flowers open their flowering glumes this time. The pollen grains from a plant may be kept in a clean sterilized glass vial until they are used.

Pollination process.—Fresh or newly gathered pollen grains should always be used for fertilization. Flowers emasculated the afternoon of the preceding day are ready to be pollinated in the morning when they open their flowering glumes. At this stage the style connecting the stigma and the ovary elongates a little. When this is observed the stigma was not injured during the time of emasculation. Some pollen grains are dropped on the stigma and the flowers are rebagged. The same needle used for emasculation may also be used for dropping pollen on the stigma. Effective fertilization may be detected by a subsequent increase in the contents of the flowering glumes.

Labeling.—A label containing the case number, date of emasculation, date of pollination, and a place for note on date of harvesting should be attached to each emasculated plant. Besides other necessary data an index reference to these should be kept in a note book.

To illustrate, the label in a given case may contain the following information: Case Ia, E–7–10–22, P–7–11–22, H–11–15–22. The letters E, P, and H stand for "Emasculated," "Pollinated," and "Harvested," respectively.

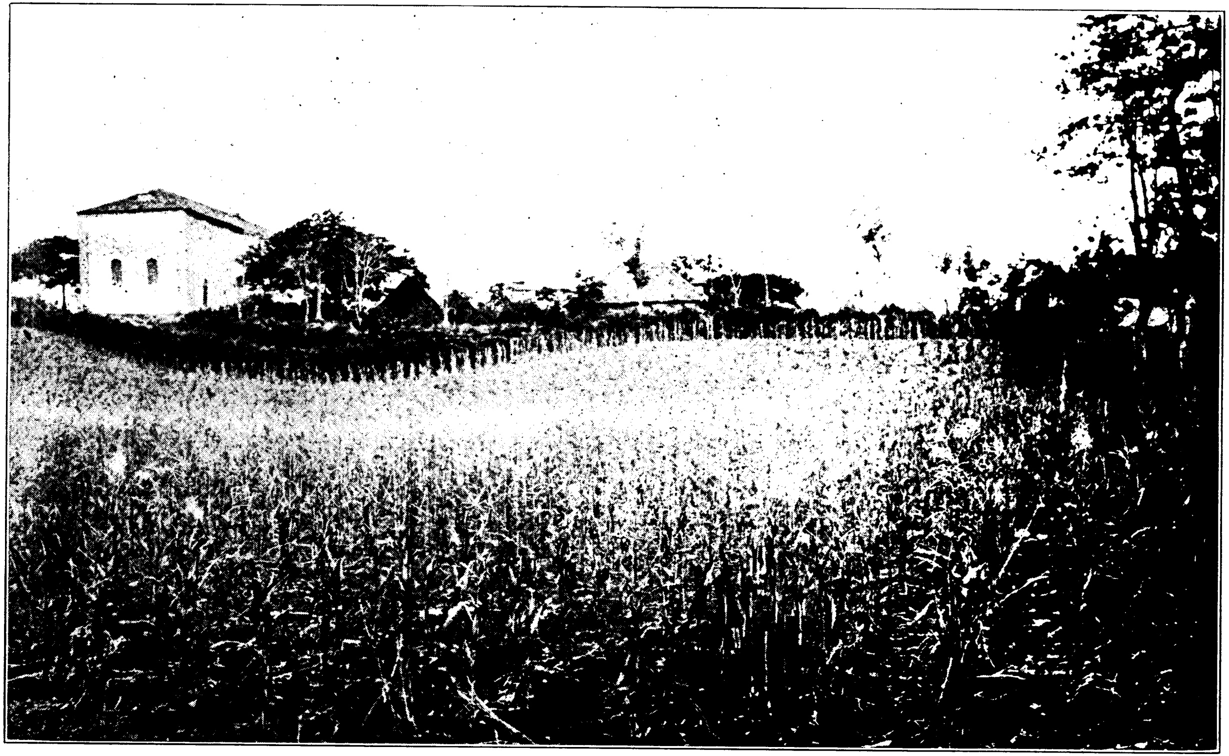
In the notebook, the following notes may be written:

	Male	Female	Purpose
Case Ia..........	Cruz..............	Apostol.........	For size of grain.

About other cases, the notebook may show the following:

	Male	Female	Purpose
Case Ia..........	Apostol.........	Cruz.............	For size of grain.
Case IIa.........	Apostol.........	Skinriki........	For height of plants.
Case IIIa.......	Inantipolo....	Pauni............	For good flavor.
Case IIIb.......	Cruz..............	Inantipolo....	For good flavor.

Care of hybrid seeds.—When the hybrid seeds are sufficiently ripe clip off the panicles at the peduncles and remove them, leaving the seeds in the paper bag. The grains should be reasonably well dried to prevent any growth of fungus. Even a little amount of moisture will favor the growth of fungus on them, as they are not completely covered with hull. Great care should be taken to preserve seeds.



Defoliated corn after a few hours of infestation

PLATE XXI

Defoliated coconut trees after a few hours infestation

INSECTICIDES FOR LOCUST EXTERMINATION

By Arsenio Goco, *Supervising Locust Inspector*

"The destruction of food and other valuable products by insects is also a familiar story but its most dramatic form is to be found in the flights of uncounted millions of locusts which occur from time to time and strike terror to the heart of the farmer. In the course of an hour or two locusts can cross a countryside and destroy almost every particle of living vegetation and the farmer must look on helplessly at the spectacle of his own ruin."—Collier's *The National Weekly,* Sept. 23, 1922.

Ignacio Villamor (Executive Secretary of the Philippine Islands and afterwards President of the University of the Philippines, Attorney-General and at present Justice of the Supreme Court) observes:

> La voracidad de las langostas forma un capítulo de ruina y hambre en la historia de este país. La gente del pueblo al ver ocultada la luz del sol, exclama aterrorizada: balang! balang! como si dijera incendio! destrucción! muerte!

Former Governor-General W. C. Forbes on February 7, 1910, said:

> In my inaugural address and in the one recently delivered at the convention of provincial governors, I placed a great deal of emphasis on these four great problems: rinderpest, locusts, road, and bridges.

Man has been trying for ages everything from magic rites and religious ceremonies and such preventive methods as those ordered by the Turks that are described in Touring in 1600, by Bates:

> * * * After they had taken Cyprus, moreover, which suffered greatly from locusts, it was prescribed that every farmer should bring a fixed quantity of locusts' eggs yearly to a stated official, who was to see the eggs ground to powder and the powder thrown into the sea.

And the Philippines being a country that the locusts enjoy living in has not been idle about devising ways and means, some of which have it is true been temporarily more or less successful but have fallen far short of solving the problem.

The war suggested a new method, naturally, and before leaving the Islands Governor-General Harrison requested the

Chief of the Chemical Warfare Service of the Philippine Department of the United States Army to detail an officer to try poison gas here. So far, however, it has not been practicable to do this on any worth while scale.

Later, Dean C. Worcester furnished Governor-General Wood with a clipping describing a South African method of poisoning the locusts with arsenic and bran sweetened with sugar and made attractive with lemon extract. This was forwarded to the Bureau of Agriculture with the order that the method be tried in the Philippines, and the Director of Agriculture assigned the writer to the task. The procedure and results were as follows:

On August 16, 1922, the work was begun as suggested in the clipping as follows:

Sodium arsenite solutions were prepared having one-half and one per cent of white arsenic respectively and two per cent of molasses. Bunches of green grass were dipped in it and scattered in the places where hoppers in the fourth stage were numerous.

As this was done just at sunset the hoppers were still moving and did not all stop where the poison was scattered, so it was necessary to broadcast poisoned grass where the locusts had settled down.

The next morning this place was visited and it was found that only a little of the poisoned grass had been eaten but that nearly all of the green grass where the hoppers had rested was eaten up.

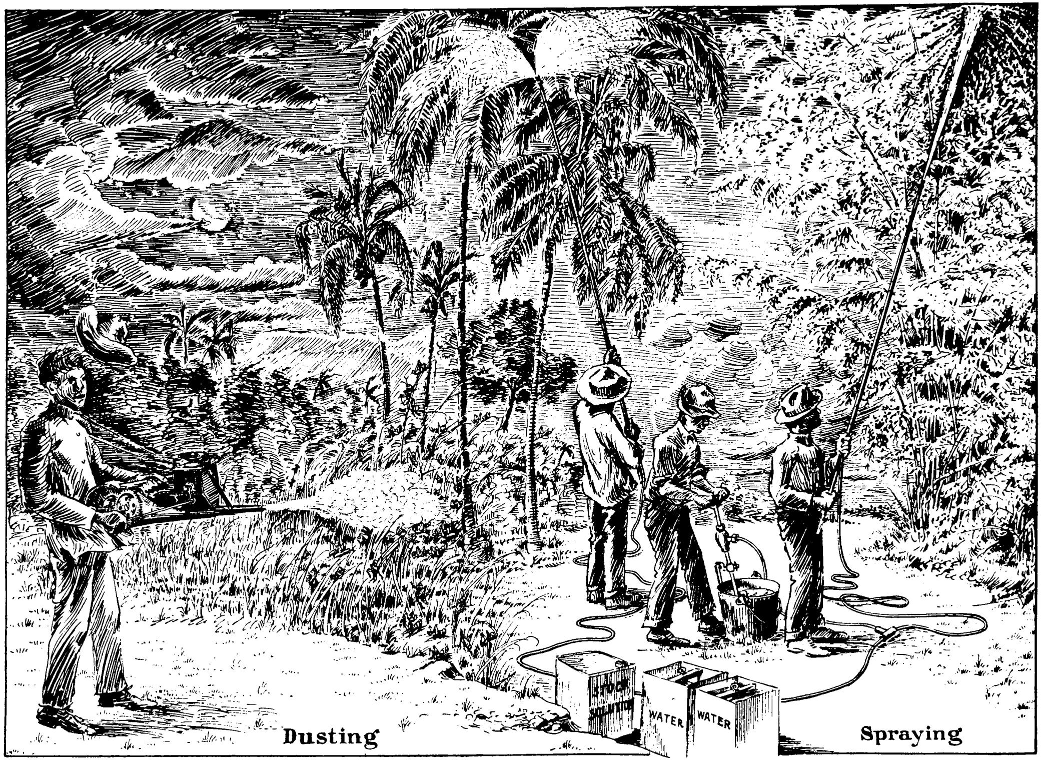
It was thus apparent that cutting and dipping grass in the poison solution was not necessary and probably it would be more effective to poison the grass where the hoppers settled.

In the evening of the same day the remaining sweetened solution was sprayed on the grasses where the hoppers had settled or were about to settle. In another place one per cent of lead arsenate in water was also sprayed to compare results.

The next morning some dead ones were found near the place where the sweetened sodium arsenite had been sprayed but no dead hoppers were found where the lead arsenate had been spread. Nevertheless the swarms were watched and followed as it was noted that the bunches of grass sprayed with sodium arsenite were not all eaten up and were drying out.

In the evening more of the dead hoppers poisoned with sodium arsenite were found but still there were none killed by lead

Defoliated bamboo after a few hours locust infestation



Methods of poisoning the locusts and hoppers in the evening

arsenate. The resting place was again noted for inspection the next morning.

When the next inspection was made the hoppers poisoned with lead arsenate were nearly all found dead or dying. The ones poisoned with sodium arsenite were still living as at the beginning of the experiment.

As in the laboratory, it took about 36 hours before the effect of the lead arsenate could be noticed it may be stated that about the same number of hours are needed in the field. The sodium arsenite took only about 12 hours but it tends to kill the grass and probably it can be tasted by the hoppers, as it is readily soluble, while lead arsenate is only very slightly so.

The lead arsenate solution was therefore applied on a large scale until its effectiveness could no longer be doubted. The bran, lemon, and amyl acetate were not tried any more as spraying is simpler. But as spraying is laborious and when the area of infestation is far from the source of water great difficulty was found in hauling water, especially when the work had to be done in the evening, so dusting was done instead of spraying. The effect on the hoppers were equally sure when the dusting was done at the time when the hoppers were about to settle for the night. In nearly all cases when dusting was done in the morning or at noon it failed of result due to the habit of the hoppers to move about when the sun shines over them.

In dusting, either lead arsenate or white arsenic was used. White arsenic killed the hoppers in half of the time it took the lead arsenate. The disadvantage of using the white arsenic is that it burns all the plants it touches and besides it is dangerous for the operator to handle. But in wild cogonals and when a dusting machine can be used white arsenic is preferable to lead arsenate, as it is cheaper and quicker.

In Tulotulo, a barrio of Sariaya, Tayabas, newly emerged flyers both white arsenic and lead arsenate were tried and both killed the flyers. As in the case of the hoppers the flyers survived quite a while although very weak.

In October a swarm of flyers reached Novaliches, Caloocan, Rizal; and in the evening alighted on trees they do not feed on. This taught us that poisoning was not always applicable.

Our failure to get a chance to spray the swarm led us to further study and for this purpose we collected some flyers for an experiment. The next morning a kerosene emulsion (whale

oil soap with kerosene) was prepared and sprayed on the locust. The locusts were drugged but only for a while. They recovered just after the evaporation of the petroleum used and even while drugged could breathe a little. But it was evident that if the breathing organs were closed while they were drugged by the kerosene recovery would be impossible.

Several soluble substances that could be used with the kerosene emulsion were thought of and finally resin was selected. This was dissolved in a soap solution, and then added to the kerosene emulsion and some locusts sprayed with the mixture. The result was gratifying. The locusts once drugged never recovered but the making of the solution was difficult as resin is not readily soluble in soap solution, and besides the solution coagulates rapidly when it is diluted with water.

To quicken the work soap was substituted, with sodium hydrate. In this the resin dissolved readily. When the resin was dissolved coconut oil was added until soap began to form. The addition of the oil made the resin coagulate again and rendered the spraying ineffective.

The idea of using a vegetable oil was therefore discarded and only enough sodium hydrate was used to dissolve the resin. After a number of trials it was found that 1 part of sodium hydrate (98 per cent) in 12 parts of water would dissolve 6 parts of resin. Six parts of petroleum were added to make the stock solution.

Before being used the solution was diluted with 8 times its volume of water and this was found effective in killing flyers in the cage.

The solution being very cheap was used for hoppers in the field in Las Piñas in October and was found very effective there also. When the hoppers were very small the dilution could be weakened to 16 times its volume. With the full grown hoppers only 10 times the volume of water could be added. When the stock solution is dissolved in ten times its volume of water the cost per 20-liter can is only 13 centavos if the ingredients are bought at wholesale prices. The spraying was done and should be done early in the morning or in the evening when the hoppers get together.

Thus a swarm of hoppers may be killed economically and one or two men will be enough to do the work in a short time.

In November, Mr. McCarthy reported that only 20 per cent to 40 per cent of the flyers could be killed with this solution. To find out why there was a difference between the laboratory

THE RESIN KEROSENE-EMULSION

While the article on locusts was in print it was discovered that an excess of caustic soda renders the solution less effective. The resin does not always coagulate when the part of the caustic soda reacts with the oil on the body of the locust, but only when there is just enough soda to dissolve it. Then it coagulates at once.

When the locusts are winged and there is an excess of soda there is a loss of effectiveness. The wings and tendons that articulate the wings, are corroded however. If there is an excess of soda the solution must be thicker than when there is no excess to kill the hoppers.

Also the caustic soda used was not 98% pure (pp. 52) but only about 80% due to exposure.

(*a*) Swarm of hoppers

(*b*) Locusts resting on coconut palms

Pit and corral method of killing locust hoppers

and the field results Mr. Aniceto Toquero was ordered by Mr. G. Merino, Chief of the Plant Pests Control Division, to go to the eastern part of Laguna where the flyers were damaging crops.

As he was requested to use different proportions of the ingredients he came to report on the stock solution of one part sodium hydrate 2 parts of resin and 5 parts of petroleum in 5 parts water. After trying different dilutions he recommended the dilution of 7 times the volume of the stock solution or the following formula:

	Per cent.
Resin	1.9
Sodium hydrate	0.95
Petroleum	4.7

This solution when applied in the evening when the flyers crowded on trees killed nearly 100 per cent of the locusts before morning. Those that were not killed could hardly fly and died shortly afterward.

The solution diluted with 10 times its volume of water took a much longer time to kill the locusts but almost none could escape. Reports from the provinces show that the original solution, which is less corrosive to the hands of the operator, is also effective when the application is thorough.

RECOMMENDATIONS

1. That instead of the laborious methods of driving the hoppers into pits and catching the flyers with nets which are not so effective the kerosene emulsion solution be used to kill locusts in all stages.

2. That when the locusts in cultivated areas are all exterminated preparation be made to meet the invading flyers from uncultivated cogonals.

3. That if possible the breeding places of locusts in Masbate and Mindanao be located by aëroplane and dusted with white arsenic and calcium arsenate, which are more effective than lead arsenate as is done in the United States and England, in combating other kind of insects.

4. That if dusting from an aëroplane is done, seeds of quick growing forest trees be scattered without additional expense. In this way the cogonals will be turned into useful areas and the wearing out of surface soil by flood will be prevented. Thus also a home *will be provided for birds that will continually*

war on the locusts and other destructive insects if they are not exterminated.

* * * * * * *

"* * * *and lastly* (said Tawaddud) *the beast the woneth not in cultivated places, but lodgeth in waste places and hateth the sons of Adam and hath in him somewhat of the make of seven strong and violent beasts, is the locust, whose head is as the head of a horse, its neck of a bull, its wings as the wings of a vulture, its feet as the feet of the camel, its tail as the tail of the serpent, its belly as the belly of the scorpion and its horns as the horns of the gazelle.*"

The Philippine Agricultural Review

VOL. XVI | SECOND QUARTER, 1923 | No. 2

FIBER NUMBER

A QUARTERLY PUBLICATION

ISSUED IN ENGLISH BY THE
BUREAU OF AGRICULTURE

The Government of the Philippine Islands
Department of Agriculture and Natural Resources

Subscription rates: ₱2 (Philippine currency) or $1 (U. S. currency) per annum in the Philippine Islands and the United States and territories.
$2 (U. S. currency) per annum in foreign countries

MANILA
BUREAU OF PRINTING
1923

(Entered at the Post Office at Manila as second-class matter)

THE PHILIPPINE

Agricultural Review

VOL. XVI SECOND QUARTER, 1923 NO. 2

TABLE OF CONTENTS

	Page.
1. Grading, Baling, and Inspection of Philippine Fibers	57
2. On the Improvement of Abaca, by Nemesio B. Mendiola	85
3. The Deterioration of Abaca Fiber, by Eladio Sablan and Mariano Villaraza	100
4. Banana Wilt of the Manila Hemp Plant, by H. Atherton Lee and F. B. Serrano	104
5. Mauritius Hemp (*Furcroea gingantea*) with Reference to its Inferiority to Abaca, Maguey and Sisal, by R. B. Espino and T. Novero	108
6. Fiber Elements of Some Fiber Agaves, by Vicente C. Aldaba	120
7. Appendix: Clasificación, Enfardaje é Inspección de Fibras Filipinas	131

196418

ILLUSTRATIONS

Facing page—

PLATE I. Bulbils and flower structures—Fig. 1. A bulbil; Fig. 2. A branch with bulbils on at the exil of flower; Fig. 3. A flower, petals removed; Fig. 4. Pollen grains; Fig. 5. A petal; Fig. 6. A stamen; Fig. 7. A pistil; and Fig. 8. A complete flower 108
II. Mauritius hemp, flowering or poling 110
III. Figs. 1, 4, 6, and 9. Big vascular bundles; Figs. 2 and 5 fiber strands with small conducting tissue; Figs. 3, 7 and 8. Purely sclerenchyma strands; Fig. 10. Portions of fiber-cells in median longitudinal view 112
IV. *Agave cantala* (Maguey) 120
V. *Agave sisalana* (Sisal) 122
VI. *Agave furcroydes* (Henequen) 124
VII. *Agave zapupe* (Zapupe) 126
VIII. *Agave gigantea* (Mauritius Hemp) 128

TEXT FIGURES

1. The completed bale showing method of wrapping, binding and tagging 63
2. Cloth tag showing: (*a*, *a*') name of grading establishment; (*b*, *b*') number of lot: (*c*, *c*') abbreviated name of district of production; (*d*, *d*') date of pressing; (*e*) name of grading station, press mark; and (*f*) the Government stamp bearing the full name of grade 65
3. Graphical comparison of tensile strength and ash contents **117**

GRADING, BALING, AND INSPECTION OF PHILIPPINE FIBERS

PART I

ADMINISTRATIVE ORDER No. 25

REGULATIONS GOVERNING THE GRADING, BALING, AND INSPECTION OPERATION OF PHILIPPINE FIBERS

MANILA, *February 8, 1923*

ADMINISTRATIVE ORDER No. 25

In accordance with the provisions of Article II of Chapter 46 of Title VII of book II of the Revised Administrative Code, the following regulations governing certain phases of the grading, baling, and inspection of Philippine fibers, are hereby issued for the information and guidance of all concerned:

These regulations cover the following subjects, namely: (1) designation of the official standard grades for each fiber included in Article III of Chapter 46 of the Title VII of Book II of the Revised Administrative Code; (2) determination of the standard grades and types thereof; (3) additional regulations regarding baling, labeling, and inspection; and (4) cancellation of previous regulations inconsistent with the provisions of the present order.

ARTICLE I.—*Designation of official standard grades*

The following named Philippine fibers are included under these regulations and a separate set of standard grades is established for each:

(1) Abaca (Manila hemp): Of excellent cleaning, specially prepared for tagal braid or other fine textile purposes.

(2) Abaca (Manila hemp): Of excellent or good cleaning.

(3) Abaca (Manila hemp) strips: Partially cleaned fiber.

(4) Abaca (Manila hemp): Woody and waste fibers.

(5) Maguey or Sisal: Retted.

(6) Cantala (Maguey) or Sisal: Knife- or machine-cleaned.

(7) Pacol and Canton.

SECTION 1. *Abaca (Manila hemp)—Of excellent cleaning, specially prepared for tagal braid or other fine textile purposes.*—The following grades shall be the official standards of classification for this fiber only when the product is carefully sorted; cleaned of all tow; of more uniform color, cleaning and texture than is required in subsequent standards:

Letter designation	Name of grade
AA	Tagal-one.
BB	Tagal-two.
CC	Tagal-three.
DD	Tagal-four.
EE	Tagal-five.

SEC. 2. *Abaca (Manila hemp)—Of excellent or good cleaning.*—The following grades shall be the official standards of classification for this fiber only when the product is in the form of fiber, i. e., well cleaned:

Letter designation	Name of grade
A	Extra prime.
B	Prime.
C	Superior current.
D	Good current.
E	Midway.
S1	Streaky No. 1.
S2	Streaky No. 2.
S3	Streaky No. 3.
F	Current.
G	Seconds.
H	Brown.

SEC. 3. *Abaca (Manila hemp) strips—Partially cleaned fiber.*—There shall be six grades of abaca when the fiber is prepared in the form of strips, which shall be designated as follows:

Letter designation	Name of grade
I	Good Fair.
J1	Fair No. 1.
J2	Fair No. 2.
K	Medium.
L	Coarse.
M	Coarse brown.

SEC. 4. *Abaca (Manila hemp)—Woody and waste fibers.*—There shall be nine grades of abaca when the fiber is hard and woody, damaged, or in the form of strings, tow or waste, which shall be designated as follows:

Letter designation	Name of grade
DL	Daet coarse.
DM	Daet coarse brown.
O	Strings (white and fine).
OO	Strings (coarse or dark).
T	Tow (white and fine).
TT	Tow (coarse or dark).
Y	Damaged (fine fiber).
YY	Damaged (coarse fiber).
W	Waste.

SEC. 5. *Maguey and Sisal—retted.*—There shall be five grades of maguey or sisal when the fiber is separated by retting the leaves in water. These grades shall be designated as follows:

Letter designation	Name of grade
Mgy or Ssl 1	Maguey or Sisal No. 1.
Mgy or Ssl 2	Maguey or Sisal No. 2.
Mgy or Ssl 3	Maguey or Sisal No. 3.
Mgy or Ssl Y	Maguey or Sisal damaged.
Mgy or Ssl W	Maguey or Sisal waste.

SEC. 6. *Cantala (maguey) or Sisal—Knife- or machine-cleaned.*—The grades for either cantala or sisal when cleaned by machinery or by knife shall be seven in number designated as follows:

Letter designation	Name of grade
Cla or Ssl A	Cantala or Sisal, good.
Cla or Ssl B	Cantala or Sisal, fair.
Cla or Ssl C	Cantala or Sisal, common.
Cla or Ssl R	Cantala or Sisal, red.
Cla or Ssl S	Cantala or Sisal, very short.
Cla or Ssl Y	Cantala or Sisal, damaged.
Cla or Ssl W	Cantala or Sisal, waste.

SEC. 7. *Pacol and Canton.*—These fibers are produced in certain parts of the Philippine Islands from plants known by the same names, which resemble both abaca and banana. Although Canton is considerably stronger than Pacol, both are considerably weaker than abaca and the adulteration of one with the other and the mixing of either or both with abaca is strictly prohibited.

Pacol shall be graded as Pacol No. 1 (Pcl 1), the well-cleaned fiber (white or dark), and Pacol No. 2 (Pcl 2), the strips or partially cleaned fiber.

There shall be as many grades of Canton as there are for abaca (Manila hemp), but the letter designation must in all cases be preceded by the word "Canton," as "Canton F," etc., in the case of Canton fiber.

The basis of classification of Canton fiber shall be the same as that adopted for abaca of the same grades, and shall be based mainly on color and cleaning.

The above-mentioned fibers shall be graded under separate lot numbers from those of abaca and other fibers, and separate certificates shall be issued for them by the fiber inspector.

Abaca fiber that has been adulterated with either Canton or Pacol fiber in such a way as to make it impracticable to separate the two, shall be graded as Canton or Pacol without regard to the percentage of pure abaca fiber that may be mixed with either of these two inferior fibers.

All bales of Canton or Pacol fiber shall have printed across the bales in types at least three inches high the word "Canton" or "Pacol," in addition to the Government grading letter-designation and the Government stamp on the muslin tag in the bale.

ARTICLE II.—*Designation of grades and types*

The grading of fiber in standards included in Article I of this order shall be based on its tensile strength, color and cleaning, except Pacol and Canton fibers which shall be based mainly on color and cleaning, as follows:

Tensile strength.—This is a basic quality, and under this system the fibers must possess an average normal breaking strength in order that it may be graded to any of the standards established in this Order; otherwise, it will be graded as "damaged," irrespective of its color or cleaning. If the proportion of weak or damaged fiber in a lot is not sufficiently high to justify the above action, then the only recourse shall be the rejection of the whole lot for sorting the weak fiber from that of normal strength. Ordinarily, practical observation and hand tests are sufficient to indicate whether or not a certain fiber possesses normal strength. In cases of doubt or dispute, however, the fiber inspector shall verify his finding by making tests with adequate strength-testing machines provided by the Government for this purpose.

Color.—The tensile strength of a lot of fiber being good, the practical grading operation will be based on its color. This quality, therefore, is the determining factor of grading well-cleaned abaca and knife- or machine-cleaned cantala (maguey) and sisal. The color of the abaca fiber ranges from brown or purple to white, and the extent of variation allowable between one grade and another is illustrated by standard samples prepared by the fiber division of the Bureau of Agriculture. These

samples may be obtained by graders and buyers upon payment in advance of ₱1 per sample.

Cleaning.—The method, or extent of cleaning (fiber extraction), often produces radical changes in the character and usefulness of the fiber, hence the establishment of a separate set of standard grades for abaca strips and one for retted maguey and sisal. In the grades included under these two sets of standards, the extent of cleaning is the determining factor, although color is also taken into consideration.

In describing the cleaning of fiber in the certificates of inspection the following terms will be used:

"Excellent," when the cleaning is perfect or nearly so, the product being pure fiber, as in the tagal grades (*see* section 1, Art. I) and also the grade "Extra prime" to "Streaky No. 3" (*see* section 2, Art. I); in the grades "Cantala or sisal" "A" to "S" (knife- or machine-cleaned) (*see* section 6, Art. I); and in the grades "Maguey or sisal No. 1" (*see* section 5, Art. I).

"Good," in the case of abaca, when the product is somewhat strippy, but the strips are fine, soft, and more or less intermixed with pure fiber, as in the grades "Current," "Seconds," "Brown," and sometimes "Good Fair;" and in the case of retted maguey and sisal, when the fiber is to a small extent spotted with hard, gummy scales, as in the grade "Maguey or sisal No. 2."

"Fair," in the case of abaca, when the product is distinctly strippy but the strips are narrow and thin, as in the grades "Good Fair," "Fair No. 1," "Fair No. 2," and "Medium," and in the case of rettled maguey and sisal, when the gummy scales on the fiber are more or less prominent, as in the grades "Maguey or sisal No. 3."

"Coarse," when the product is entirely strippy, and the strips are wide, pulpy, or both, as in the grades "Coarse," "Coarse Brown," and the two Daet grades.

In addition to strength, color and extent of cleaning there are two other characteristics in a fiber which do not affect its grade but are often considered necessary to identify its type in any of the grades. These are *texture* and *length.*

The *texture* of a fiber, in most cases, varies according to its cleaning. This will, therefore, be designated as "Soft," "Medium," or "Hard," according as the cleaning is "excellent," "good," or "fair," or "coarse." Some varieties of abaca in North and South Mindanao produce a fiber which is naturally of medium or hard texture, though it may be of excellent cleaning.

Under *length,* abaca will be designated "very long," when it exceeds 3 meters (10 feet); "long," when it is $2\frac{1}{2}$ to 3 meters (8 to 10 feet); "normal," when it is $1\frac{1}{2}$ to $2\frac{1}{2}$ meters (5 to 8 feet); and "short," when it is under $1\frac{1}{2}$ meters (5 feet).

Maguey and Sisal will be designated "long," when 1 meter (40 inches) or more in length; "normal," when between 60 centimeters and 1 meter (24 to 40 inches); "short," when between 50 and 60 centimeters (20 to 25 inches); and "very short," when under 50 centimeters (20 inches).

ARTICLE III.—*Baling, Labeling, and Inspection*

The following additional regulations regarding baling, labeling, and inspection of bales shall be complied with by all grading establishments.

SECTION 1. Each hank in a bale of fiber for cordage purposes shall not exceed 12, nor be less than 6 centimeters in diameter before pressing, but in a bale for tagal braid each hank may be less than 6 centimeters.

Every bale of fiber shall be free from strings, waste, tow, damaged fiber, fiber not identical with that which constitutes the bale, or any extraneous matter, and the fiber shall be thoroughly dry.

All hanks of fiber in a bale shall be uniform in quality and each hank shall also be securely tied by a strand to hold the fibers together and which shall be identical with the fiber which constitutes the bale. The manner of tying the hank withouth forming a knot and the size of the strand to be used are illustrated in the standard samples. Neither end of the strand should be knotted.

SEC 2. The dimensions of each bale of the grades "Tagal-one," to "Tagal-five," inclusive, may be increased not more than 40 per cent over the measurements prescribed in section 1783 of the Administrative Code (Act 2711).

SEC. 3. The division of each hank into two or three parts, and the twisting of these parts in a manner similar to the twisting of the strands of a rope, is prohibited. The hank may, however, be twisted once or twice as a whole sufficiently to keep the fibers together.

SEC. 4. The hanks shall be laid straight in the bale, the heads (butt ends) in one row, alternating with the tips (points) of the next row. The hanks shall not be doubled upon themselves more than is absolutely necessary.

SEC. 5. Each bale of fiber shall be securely bound with not more than eight side and four end bands, made of the same kind of fiber as that contained in the bale, or of bejuco (rattan). The outer bands shall not be nearer than 10 centimeters to the edge. (*See* fig. 1).

SEC. 6. All fiber on being graded shall be divided into lots, The fiber in each lot shall be of uniform type, but may be of more than one grade. The lots must be numbered consecutively, and a range of numbers will be furnished each grading establishment along with the grading permits, which numbers may be repeated as soon as exhausted. The inspection of a shipment of fiber

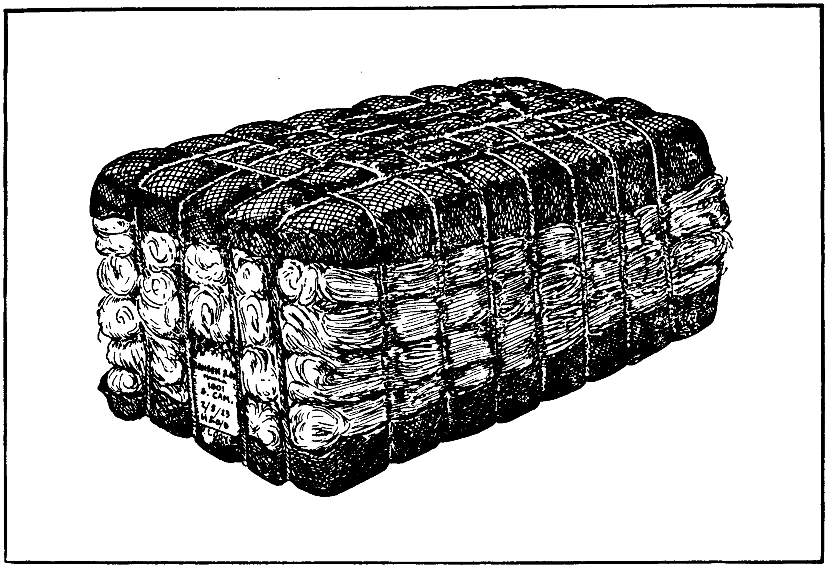


Fig. 1. The completed bale showing method of wrapping, binding, and tagging.

shall be made on each lot separately, and a separate certificate of inspection given for each lot inspected. A lot of fiber shall be considered under inspection until all the bales of all the grades included in it shall have been stamped and the required certificate of inspection issued therefor.

In order to avoid unnecessary confusion and to obtain uniformity in type, the attention of the grades is called to the necessity of dividing their lots in such a way as to have in one lot fiber which comes from one province or district only. Otherwise, any readjustment of lots may entail unnecessary trouble and expense to the grade.

In order to facilitate the division of fiber into lots uniform in type, the abaca producing provinces of the Philippine Islands shall be divided into the following districts, the product of each of which may be considered by the grader as uniform and may be included in one lot:

Province or island	District	Abbreviation
North Camarines	North Camarines	N. Cam.
South Camarines	South Camarines	S. Cam.
Albay	Albay (including Catanduanes)	Albay
Sorsogon	North Sorsogon	N. Sor.
	South Sorsogon	S. Sor.
Samar	North Samar	N. Sam.
	South Samar	S. Sam.
Leyte	East Leyte	E. Ley.
	West Leyte	W. Ley.
Mindanao Island	North Mindanao	N. Min.
	South Mindanao	S. Min.

The remaining abaca-producing provinces shall each be considered a separate district by itself.

In order to facilitate the identification of the baling establishment where a bale or bales of fiber in a lot were pressed, the following grading stations will be known by the following permanent initials which shall be placed before the press mark separated by an inclined bar:

Baybay	(Leyte)—B
Borongan	(Samar)—BO
Bulan	(Sorsogon)—BU
Cagayan	(Misamis)—K
Calbayog	(Samar)—CA
Carigara	(Leyte)—CR
Casiguran	(Sorsogon)—CS
Catarman	(Samar)—CM
Catbalogan	(Samar)—CT
Cebu	(Cebu)—C
Daet	(North Camarines)—D
Davao	(Davao)—DA
Daliaoan	(Davao)—DL
Donsol	(Sorsogon)—DS
Goa	(South Camarines)—GO
Gubat	(Sorsogon)—G
Iloilo	(Iloilo)—I
Iriga	(South Camarines)—IR
Lagonoy	(South Camarines)—LA
Laoang	(Samar)—LN
Legaspi	(Albay)—L
Ligao	(Albay)—LI
Maasin	(Leyte)—MA
Malita	(Davao)—ML
Malitbog	(Leyte)—MG
Manila	(Manila)—M
Masbate	(Masbate)—MS
Mati	(Davao)—MI
Matnog	(Sorsogon)—MT
Mauban	(Tayabas)—MU
Naga	(South Camarines)—N
Nato	(South Camarines)—NT
Palompon	(Leyte)—P
Sagnay	(South Camarines)—SY
San José	(South Camarines)—SJ
Sorsogon	(Sorsogon)—S
Surigao	(Surigao)—SU
Tabaco	(Albay)—T
Tacloban	(Leyte)—TL
Talomo	(Davao)—TO
Tigaon	(South Camarines)—TI
Vigan	(Ilocos Sur)—V
Virac	(Catanduanes)—VC
Zamboanga	(Zamboanga)—ZZ

SEC. 7. Each bale of fiber shall bear a tag of white, unstarched, cotton cloth not less than 75 centimeters long nor less than

10 centimeters wide. One end of this tag shall be placed at or near the middle of the bale, while the other end shall project about 12 centimeters beyond the end of the bale and shall be clearly visible. (*See* fig. 1.) The end of the tag inside the bale shall be tied to one of the hanks in the middle of the bale and just below the tie shall bear the full or abbreviated name of the grading establishment, the number of the lot, the full or abbreviated name of the province or district of production, and the date of pressing. (*See* fig. 2, *a*, *b*, *c*, *d*.) The end projecting beyond the bale shall be divided into two sections, the section adjacent to the bale shall bear the same data as are stamped on the end inside the bale, including the date of pressing, while the outer section shall bear the abbreviated name of the grading station accompanied by the press mark and the official letter-designation of the grade, the three separated by bars, but forming one mark and, below this, the Government stamp giving the official name of the grade in full. (*See* fig. 2, a', b', c', d', e, f.)

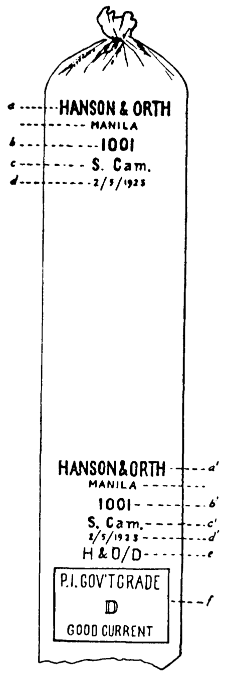


Fig. 2. Cloth tag showing *(a, a')* name of grading establishment; *(b, b')* number of lot; *(c, c')* abbreviated name of district of production; *(d, d')* date of pressing; *(e)* name of grading station, press mark, and letter designation of grade all forming one mark; and *(f)* the Government stamp bearing the full name of grade.

The letters and numeral stamped on the cloth tag mentioned in this section shall not be less than 1 centimeter in height.

On the mats covering the two surfaces of the bale shall be stamped or stenciled in clear indelible ink the same mark or brand which appears on the cloth tag outside the table.

ARTICLE IV.—*Cancellation of previous regulations inconsistent with the present order*

This order shall take effect six months from the date of its approval by the Secretary of Agriculture and Natural Resources.

All regulations issued previously which are in conflict with the present Administrative Order are hereby repealed.

(Sgd.) ADN. HERNANDEZ
Director of Agriculture

Approved, April 2, 1923.

(Sgd.) RAFAEL CORPUS
Secretary of Agriculture and Natural Resources

Part II

STRENGTH OF HARD FIBERS

The abaca (Manila hemp), maguey, and sisal fibers belong to one of the two natural groups of long fibers, known as hard fibers. The long fibers constitute two natural groups: (1) soft fibers, or bast fibers, such as flax, hemp, jute, and ramie; and (2) hard fibers, such as abaca (Manila hemp), maguey, sisal, henequen, and phormium (New Zealand hemp).

The strands of the soft fibers vary greatly in thickness and they usually cling together in such a way as to make it practically impossible to select single strands for comparison. The hard fibers, however, to which the abaca (Manila hemp) sisal and maguey fibers belong present single strands which are sufficiently uniform and free from clinging strands to be selected for breaking, but they are not uniform enough to be directly compared. A coarse, hard fiber may break at a higher tensile strain than a finer one, yet the fine one may be much stronger when compared with equal bulk or weight for weight. Weight is more satisfactory for comparison than diameter or bulk and it is more easily determined. For comparison, therefore, the breaking strain of each sample is computed to the convenient, but arbitrary standard of a fiber weighing 1 gram per meter of length.

In testing the above mentioned hard fibers the following method is pursued:

Ten fibers are selected from the sample and their length measured, after which they are weighed. They are then broken in the testing machine. The breaking strain divided by the weight per meter gives the breaking strain per gram meter.

The following is an average tensile strength of not less than ten tests of the different grades of abaca (Manila hemp), sisal, and maguey fibers from different districts of production:

ABACA (MANILA HEMP)

Grade	Breaking strain per gram meter	Grade	Breaking strain per gram meter
	Grams		*Grams*
A	49,304	G	47,057
B	48,889	H	47,029
C	50,559	I	46,351
D	52,075	J	45,553
E	50,240	K	41,012
S1	52,670	L	35,912
S2	52,861	M	40,350
S3	52,873	DL	33,873
F	52,415	DM	30,472

MAGUEY (RETTED)

Grade	Breaking strain per gram meter
	Grams
Mgy 1	23,249
Mgy 2	24,066
Mgy 3	23,668

SISAL (RETTED)

Grade	Breaking strain per gram meter
	Grams
Ssl 1	22,734
Ssl 2	26,173
Ssl 3	21,966

CANTALA OR (MAGUEY MACHINE-CLEANED)

Grade	Breaking strain per gram meter
	Grams
Cla A	26,005
Cla B	26,798
Cla C	25,812
Cla R	21,409

SISAL (MACHINE-CLEANED)

Grade	Breaking strain per gram meter
	Grams
Ssl A	30,778
Ssl B	32,181
Ssl C	28,304

The several different grades of abaca (Manila hemp) which are recognized in the market are due chiefly to the different knives used (smooth or serrated) in cleaning the fiber, and to greater or less care in adjusting the knife, therefore, this fiber presents a wide variation in weight per meter and in strength.

The above figures, being averages of ten or more tests they do not, therefore, represent the extreme limits.

PART III

DESCRIPTION OF THE STANDARD GRADES OF ABACA (MANILA HEMP) FIBER

The number and designation of the official standard grades of the chief commercial fibers of the Philippine Islands are given in Article I of Bureau of Agriculture Administrative Order No. 25. In Article II of the same order are explained the principal characteristics which, in each of the fiber included in the regulations, determine the grade and its type, but no attempt is made to give a specific description of each grade. It is the object of this paper to give such a description and it is intended that this description shall be based on the apparent qualities of the fiber in each grade, and the variations which may be encountered in the character of the fiber in the different districts where it is produced.

Such a description is difficult in the case of abaca perhaps more so than of any other hard fiber, and it is presupposed that the reader has a practical knowledge of the commercial grades of this fiber before he can thoroughly understand this description. It is true that an accurate understanding of the

grades of abaca can be obtained only by continued examination and handling of the fiber on a more or less large scale. The same thing is true in the case of almost all other fibers although abaca presents a particular difficulty owing to the variable methods used in its preparation and preliminary handling. In spite of all these difficulties, it is believed that a specific description of the grades as is proposed in this article, although it may be practically unintelligible to the layman, may prove of considerable help to all persons who have had experience with Philippine fibers.

For the purposes of this article the standard grades of abaca are classed under four groups, according to the extent of their cleaning, or fiber extraction. The grades of each group will be described separately, beginning with the lowest grade, thus showing as clearly as possible the gradation which exists in their apparent characteristics.

STANDARD GRADES OF ABACA (MANILA HEMP)

GROUP I.—*Those of excellent cleaning*

The grades included in this group are "Extra prime" to "Streakly No. 3" excluding "Current," which is oftener of good than of excellent cleaning. In these grades the cleaning is perfect, or nearly so, and the products is practically pure fiber, hence the texture is generally soft (except in the product of South and North Mindanao which is sometimes medium in texture) and the tensile strength is at its highest average. While the grades of this group are to a greater or less extent produced in every province, they form the bulk of production only in Cavite, Mindoro, South Mindanao (Davao Province), Samar, West Leyte, Tayabas (Marinduque), and Panay (Capiz and Iloilo).

Streaky No. 3.—This grade is produced entirely from the outside sheaths of certain varieties of the abaca plant, the color of which is naturally dark. For this reason the predominant *color* of the fiber is a light purple, with but few streaks of dingy white fiber running through it. The color of the fiber from the middle towards the tip is usually darker than the rest. In this grade the fiber is invariably short, rarely exceeding 1.25 meters (4 feet) in *length.*

Streaky No. 2.—This grade is produced from sheaths next to those on the outside of the abaca stalk of the same varieties from which "Streaky No. 3" is produced, or from the outside sheaths of other varieties in which the stalks are naturally of a lighter color. The *color* of this fiber is a mixture, in more

or less equal proportion, of dingy white and red, or light purple. The fiber is almost invariably short, rarely if ever exceeding 1.5 meters (5 feet) in *length.*

Streaky No. 1.—This grade is also produced from the few sheaths next to those on the outside of the abaca stalk. These sheaths are slightly longer and less colored than the outer ones, hence the predominant *color* of the fiber is a light ivory-yellow or light ochre, mixed with a few streaks of a light reddish color. The length of the fiber is usually short although fiber of normal length is sometimes encountered.

Midway.—This grade is as a rule obtained from the middle sheaths of the abaca stalk which are of a light ochre color and extend the whole length of the stalk. Purple or red colors in any noticeable quantities are absent in this grade, and the length of the fiber is entirely governed by the extent of growth of the plant. In the typical grade the characteristic *color* of the fiber may be described as ochre, often interspersed with traces of a slight ivory-yellow color which really belongs to the next higher grade. The proportion of "Midway" fiber in the abaca stalk, when the fiber is cleaned and dried carefully, does not exceed 10 to 15 per cent. This proves that the bulk of the production of this grade in such provinces as Samar, Leyte, and North Mindanao cannot be entirely typical. A large proportion of "Midway" fiber as is generally encountered in the market is nothing more than a "Good Current" fiber which has depreciated in color on account of improper drying and handling. Such "Midway" fiber may be distinguished from that of the typical grade by the lack of the luster which the latter often exhibits.

"Midway" fiber is not infrequently encountered in which the cleaning cannot be called strictly excellent, it being slightly strippy and more in the nature of "Current" fiber. In such cases, however, the strips are usually soft and fine, with a high color almost approaching that of "Good Current." Sorsogon, Albay, and Camarines "Midway" are often of this nature.

Good current.—The predominant color of the fiber in this grade is a very light ochre, interspersed with considerable quantities of a light ivory-yellow fiber. The *length* is normal or long, depending entirely on the extent of growth of the plant. The texture is generally soft, except in the case of the varieties of the plant which produce a fiber naturally of a hard or medium texture.

This grade is the lowest of the so-called superior grades. It will be well for the industry if the production of this grade can

be increased at the expense of some of the low, strippy grades. It may be safely stated that in those provinces where more or less up-to-date methods are being used by the progressive element of producers, the average production is rarely under "Good Current" and in some cases it is even higher.

Superior current.—The *color* of fiber in this grade is a light ivory-yellow, a considerable portion of which usually approaches white. In *length, texture,* and *cleaning,* the fiber is essentially the same as in "Good Current," perhaps slightly softer and better cleaned in some instances.

This grade, although the third in regard to quality, can safely be called the highest for cordage purposes, the "Prime" and "Extra prime" grades being used only on a very small scale for this purpose. The production of this grade is also, unfortunately, much below what it should be. Quite a large proportion of it is used in Japan for the manufacture of hat braid, commonly known as "tagal."

Prime and extra prime.—These grades constitute the second and first, respectively, of the superior grades. They are described together because their characteristics are very much the same in respect to *texture, cleaning,* and *length* of fiber. The *color* of the fiber in both grades is practically white, although it is a little more so in "Extra prime." These two grades are obtained from the interior sheaths around the core of the abaca stalk. These sheaths are naturally whiter, softer, and a little shorter than those immediately surrounding them. For this reason the texture is always soft, irrespective of the variety of plant or district of production.

The best fiber of these grades comes from the Provinces of Cavite, Davao, and Camarines. In fact, these provinces produce the bulk of this fiber. By far the larger proportion of these two grades is being exported to Japan for the manufacture of tagal braid, for which very much higher prices are paid than can possibly be paid by the cordage trade.

GROUP 2.—*Those of good cleaning*

The grades included in this group are "Current," "Seconds," and "Brown." The grade "Good Fair" as produced in Samar, West Leyte, and a few other provinces or districts producing the so-called soft grades comes under this group, but the grade in general belongs to the next group, in which it will be included.

In these grades the cleaning is not perfect and the product is usually in the form of very fine soft strips, or a mixture of

pure fiber and fine, soft strips, which for all practical purposes may be considered fiber, the latter form being perhaps more prevalent. For this reason the cleaning is generally described as "good," and the texture as "medium."

Brown.—This is the lowest grade in this group. Its *color* is usually dark brown or brown, more so towards the tips of the fiber, due to the fact that the tips of the outside sheaths of the abaca stalk from which it is produced are thin and are usually in a more or less dried condition thus rendering the separation of the pulp difficult. The grade "Brown," as produced in East Leyte is usually of a darker color than in most other provinces, due to the prevalence there of varieties of the plant having dark-colored stalks. The *texture* of the fiber is usually medium and its *length* short.

This grade is sometimes encountered in fiber originally of a higher grade, but which, owing to subsequent neglect in proper handling and drying, has become dark. Such fiber usually has a greater length than that of the typical grade. This grade corresponds to "Streaky No. 3" of the grades of excellent cleaning, the difference between them being in the extent of cleaning, which accounts for the darker color and comparatively harder texture of the grade "Brown."

Seconds.—This grade is produced from the same sheaths of the abaca stalk from which "Streaky No. 2" is produced, the difference between the two grades being in the extent of cleaning, the same as that between "Brown" and "Streaky No. 3." The *color* of fiber in the grade "Seconds" is therefore a mixture, usually light green with light brown, the tips being generally darker than the rest, similar to the "Streaky" and "Brown" grades. The length of the fiber in the typical grade is often short than normal.

It is not always the natural color of the stalk which is responsible for the pecular mixed color of this and the "Brown" and "Streaky" grades, but any considerable injuries to the stalk, such as bruises, or partial decay caused by felling or delay in cleaning of the fiber, produce the same or a similar effect. In the latter case, however, the color is more of a light yellow or red than light brown or green.

This grade also may be encountered in fiber originally of a higher grade, but which, owing to improper cleaning and drying, becomes a little too dark for that grade. The color of such fiber differs from the typical color described above, being dingy red or light brown throughout.

Current.—The *color* characteristic of this grade is as hard to describe as those of the grades "Midway" to "Extra prime." It is a shade of very light brown, and is caused by the action of the acid when this is allowed to remain on the fiber for any length of time. This often happens when the fiber is either not thoroughly cleaned or when it is not dried promptly after its separation from the pulp. The *texture* of the fiber is medium, except in those cases in which a "Midway" fiber has so deteriorated in color as to render necessary its grading as "Current." Such fiber will be described as being of soft texture and excellent cleaning, and is usually produced in Samar, Leyte, and in some unimportant districts, such as Mindoro, Marinduque, Cebu and others, where the superior grades form the bulk of production. The *length* of the fiber is normal or long, the latter being produced chiefly in some of the North and South Mindanao provinces.

This grade is unquestionably the most important of all the grades of abaca which are of good or excellent cleaning. Its importance does not consist in any superior quality of its fiber, but in the extent of its supply and the demand for it.

GROUP 3.—*Those of fair cleaning*

The grades included in this group are "Good Fair," "Fair No. 1," "Fair No. 2," and "Medium." In these grades the cleaning is generally described as fair, and the texture medium or hard, the product being either pure strips or slightly mixed with fiber proper. The two lower grades of this group are the highest grades of the so-called U. K. (United Kingdom) fiber, for the reason that nearly all of this fiber produced is purchased by British cordage manufacturers.

Medium.—The *color* of fiber in this grade ranges from light to dark brown, or, in other words, it comprises the low seconds, and brown colors. The *length* of fiber is usually short in the typical grade, and normal in fiber originally prepared as "Fair" and subsequently reduced to this grade on account of improper drying and handling.

Fair No. 2.—This grade is the highest among the so-called U. K. grades, corresponding, as a rule, to the grade "Fair Current U. K." and "Superior Seconds U. K." of the old standard. The *color* of fiber in this grade is of high seconds, and in length it is almost invariably normal, being rarely long or short. The typical grade coming from Albay or Camarines, which is of hard texture and good color, is more in demand for the European trade.

In point of production, this grade ranks second only to "Current."

Fair No. 1.—The *color* of fiber in this grade ranges from that of high seconds to current. The fiber is comparatively soft in *texture.* This grade is more or less equivalent to "Superior Seconds U. S." and 50 per cent over "Superior Seconds U. S." of the old standard.

Good fair.—Owing to the variable method of cleaning abaca fiber in the several provinces, a large quantity of fiber is produced which is considered too good for "Fair No. 1" and too low for "Current". Its color, cleaning and texture are also such as would render undesirable its inclusion in "Seconds". For these reasons it was considered necessary to establish a separate grade for this fiber.

Typical "Good Fair" fiber is of fair *cleaning,* medium *texture,* and current *color,* and is generally produced in Albay, Sorsogon, and Camarines. Such "Good Fair" fiber as comes from Samar, Leyte, and other provinces, which produce superior grades mostly, is, as a rule, of good cleaning and medium texture, the same as "Current," but too low and dingy in color to be placed in the latter grade. The *length,* of fiber is generally normal, as in the grades "Current," "Fair No. 1" and "Fair No. 2".

GROUP 4.—*Those of coarse cleaning*

The grades included in this group are "Coarse," "Coarse brown," "Daet Coarse," and "Daet Coarse Brown". The fiber in the two latter grades is more in the nature of straw material than actual fiber, hence their description will be given after that of the first two grades of the regular standard. The fiber in the grades of this group is in the form of pure strips and may be described as hard in *texture* and of coarse *cleaning,* with some variation of degree in the several districts of its production.

Coarse brown.—Strictly speaking, this is the lowest of the grades proper. In *color* it is the same as that of "Medium," ranging from that of low seconds to brown; in *texture,* it is always hard, although comparatively softer in some provinces or districts than in others; and in *cleaning,* it is always coarse, the strips being distinctly wider and, as a rule, thicker than those of the grade "Medium". The *length* of fiber is either short or normal, not infrequently mixed.

Coarse.—This is the highest grade of this group. Its color is similar to that of "Fair No. 2" ranging from that of high Seconds to Current. In *texture* and *cleaning* it is identical with the preceding grade.

Practically the entire supply of "Coarse" and "Coarse Brown" is exported to Great Britain and other European countries, where

they are the most popular grades, not for any superior quality, but for economic reasons. The best type of these grades is produced in Legaspi (Albay) and Lagonoy (South Camarines).

Daet grades.—In *color* and *length* of fiber the "Daet coarse" and "Daet coarse brown" are identical with "Coarse" and "Coarse brown," respectively. The cleaning of the fiber in the former grades, however, is so poor and the strips are so wide and thick that it is with only a stretch of the imagination that they can be considered as fiber. For this reason these have been designated in Administrative Order No. 25 under the standard for woody fibers. This type of fiber is produced mainly in Camarines, the Tabaco and Virac districts of Albay, Negros Island and a little is prodcued in the Districts of North Mindanao.

It is very doubtful whether the Daet grades can be used to advantage for cordage purposes, except perhaps as a mixture with the higher grades. There can be no doubt that the production of this type of fiber has hurt the reputation of our abaca, and for this and local economic reasons its production should be discouraged.

PART IV

LETTER DESIGNATIONS, NAMES OF STANDARD GRADES AND EQUIVALENCE IN THE OLD GRADING

Letter designation	Name of grade	Old names
A	Extra Prime	F. E. A. quality—100 per cent over good current.
B	Prime	F. E. B. quality—62½ per cent and 75 per cent over good current.
C	Superior Current	37½ per cent and 50 per cent over good current.
D	Good Current	Good current and 25 per cent over good current.
E	Midway	Midway or 50 per cent; 62½ per cent and 75 per cent over Fair current U. S.
S1	Streaky No. 1	Leyte Superior Seconds.
S2	Streaky No. 2	Leyte Good Seconds.
S3	Streaky No. 3	Leyte Fair Seconds.
F	Current	25 per cent and 37½ per cent over Fair Current U. S.
G	Seconds	Soft and Medium seconds U. S.
H	Brown	Soft and Medium browns U. S.
I	Good Fair	Fair current and 12½ per cent over Fair current U. S.
J1	Fair No. 1	Superior seconds U. S.; and 50 per cent over Superior Seconds U. S.
J2	Fair No. 2	Fair current U. K.; and Superior Seconds U.K.
K	Medium	Medium browns U. K.; and Fair Seconds U. K.
L	Coarse	Good Seconds U. K.
M	Coarse Brown	Good browns U. K.; and Fair browns U. K.
DL	Daet Coarse	Daet current; and Daet seconds.
DM	Daet Coarse Brown-Daet reds.	
O	Strings (white and fine).	
OO	Strings (dark or coarse).	
T	Tow (white and fine).	
TT	Tow (dark or coarse).	
Y	Damaged (fine fiber).	
YY	Damaged (coarse fiber).	
W	Waste.	

PART V

ADMINISTRATIVE CODE: ARTICLE III, CHAPTER 46, TITLE VII, BOOK II

ARTICLE III.—*Grading of fibers*

SECTION 1771. *Words and phrases defined.*—Words and phrases used in this article shall be taken in the sense indicated below:

(*a*) "Fiber" is used with reference to its common and commercial significance and not to its scientific meaning. In this article the term means the raw material only and not fibers partially or entirely manufactured.

(*b*) "Abaca" shall mean the fiber of the plant of the same name, which is known technically as *Musa textilis* and commercially as "Manila hemp," "Manila," and "hemp."

(*c*) "Maguey" (cantala) shall mean the fiber of the plant of the same name, which is known technically as *Agave cantala Roxb.*, and commercially as "maguey," "Manila maguey," and "Philippine maguey."

(*d*) "Sisal" shall mean the fiber of the true sisal plant, *Agave sisalana* Per., which is sometimes known locally as "maguey de Hawaii."

(*e*) "Strand" shall mean several fibers twisted together by hand for tying bundles or hanks.

(*f*) "Strings" shall mean a handmade rope or strand of abaca, maguey, or sisal which has been used for tying several bundles or hanks together.

(*g*) "Tow" shall mean pieces of broken fiber or fine fibers, interwoven in such a way as to break wholly or in part during the operation of carding at the mill.

(*h*) "Waste" shall mean the broken fiber or partially cleaned fiber strips which fall under the knife or machine during the operation of fiber extraction.

SEC. 1772. *Official standards for commercial grades of fibers.*—The Director of Agriculture shall determine the official standards for the various commercial grades of abaca, maguey and sisal. Each grade shall have its proper designation and a corresponding distinctive mark, both of which, together with the basis upon which the several grades are determined, shall be defined by the Director of Agriculture in a general order. Such order shall have the approval of the Department Head; and for the dissemination of information, copies of the same

shall be supplied *gratis* to the foreign markets, provincial governors, municipal presidents, and to such other persons and agencies as shall make request therefor.

If any of these standards should at any time be changed notice shall be given in the local and foreign markets for a period of at least six months before the new standard shall go into effect.

SEC. 1773. *Official standards for certain other fibers.*—When the condition of the fiber trade renders such course expedient, the Director of Agriculture may likewise fix standard grades for abaca which may have been partially cleaned or prepared in the form of tow, waste or strings. He may also establish standards for the fiber of any species of *Musa* other than abaca for which there shall be a demand in the market.

SEC. 1774. *Preservation of official standards.*—The originals of all official standards shall be prepared in suitable form and shall be securely kept in the Bureau of Agriculture, being subject to renewal in the discretion of the Director of Agriculture, but without variation of the standards, as occasion may require.

SEC. 1775. *Supply of secondary standards for uses of trade.*—Specimens of the different grades of fibers conforming to the original official standards shall be prepared by the fiber division of the Bureau of Agriculture, and after certification by the Director of Agriculture shall, upon request, be supplied, as secondary official standards, to all authorized grading establishments, provincial governments, chambers of commerce, planters' associations, and other persons or institution directly interested in the trade, the actual cost of such specimens to be paid in advance by the party requesting the same.

Secondary standards prepared by the Bureau of Agriculture, as well as authorized sets prepared by grading establishments and duly certified, shall be deemed to be official standards for all purposes.

SEC. 1776. *Renewal of secondary standards by grading establishments.*—Grading establishments may, solely for their own use, prepare duplicates of secondary official standards kept by them; but it shall be unlawful for any person to use such duplicate before it shall have been approved and certified by the Director of Agriculture or his authorized agent.

SEC. 1777. *Classes of grading establishments.*—There shall be six classes of grading establishments which shall be classified (according to the quantity of loose fiber they grade and bale per annum) as follows: First-class establishments, handling five thousand metric tons and above; second-class establishments

handling between two thousands five hundred and five thousand metric tons; third-class establishments, handling between two thousand and two thousand five hundred metric tons; fourth-class establishments, handling between one thousand and two thousand metric tons; fifth-class establishments, handling between five hundred and one thousand metric tons; and sixth-class establishments, handling less than five hundred metric tons.

The classification of grading establishments shall be based on the quantity of fiber graded and baled during the year previous to the one for which a grading permit is desired. In the case of a new establishment, the classification shall be made at the end of the first year and it shall pay the fee corresponding to such year; and the Director of Agriculture may, in his discretion, require a bond in a reasonable amount to secure such payment.

SEC. 1778. *Grading permits.*—No person shall engage in grading abacá, maguey, or sisal, unless a permit shall have previously been obtained, which shall be signed by the Director of Agriculture, such permits to be known as "grading permits."

SEC. 1779. *Fees for grading permits.*—Grading permits shall be furnished to any grading establishments the owner or owners of which shall prove to the Director of Agriculture that they possess the necessary qualifications to carry on the work and on payment in advance of an annual fee of one thousand pesos for first-class, five-hundred pesos for second-class, two hundred and fifty pesos for third-class, one hundred pesos for fourth-class, fifty pesos for fifth-class, and twenty-five pesos for sixth-class establishments.

SEC. 1780. *Charges for grading and baling.*—So far as their facilities shall extend beyond the requirements of their own business, grading establishments shall grade and bale fibers for other owners when delivered in fit condition for such process. No grading establishment shall charge more than eight pesos per metric ton for baling and grading any fiber within the purview of this law; but any expense incident to tying the fiber into hanks of proper size or drying it, if wet, shall be borne by the owner.

SEC. 1781. *Grading of fibers.*—In the grading of fibers, each grade prepared shall correspond to one of the official standards, and it shall also bear the same designation and mark as the latter. The set of official standards shall be placed in a prominent position in the grading shed for reference.

SEC. 1782. *Use of private marks by exporters.*—Every grading establishment shall have the right to use private marks, or brands, in connection with the name of the official standard, providing that such marks shall have been previously registered at the Bureau of Agriculture and their use authorized by the same, and also providing that each mark shall constantly refer to the same official standard or a specified type thereof. Application forms for the registration of private marks can be obtained free of charge from the Director of Agriculture.

The Director of Agriculture may, after giving the grading establishment one month's notice in writing, cancel the brand or brands of any grading establishment when it shall have been proved that such brand or brands have not been constant or if their use shall have led to mistakes or confusion. The order of cancellation shall take effect immediately, without prejudice to carrying the matter in appeal to the Department Head, who, in the case of a decision adverse to the Director of Agriculture, shall order that the brand or brands canceled be restored.

SEC. 1783. *Baling of fibers for export.*—All fibers within the purview of this law which are intended for export shall be pressed in bales approximately of the following dimensions and weight: Length, one meter; width, fifty centimeters; height, fifty centimeters; and weight, one hundred and twenty-five kilos, net.

Every bale of fiber shall be free from strings, waste, tow, damaged fiber, fiber not identical with that which constitutes the bale, or any extraneous matter, and the fiber shall be thoroughly dry.

All hanks of fiber contained in a bale shall be uniform in quality, and each hank shall also be securely tied by a strand to hold the hank together, and which shall be identical with the fiber which constitutes the bale.

In any grade of abaca in which the quality of the fiber may be injured by excessive pressure, the approximate dimensions and weight of each bale of such fiber shall be determined in a general order by the Director of Agriculture. He shall in like manner determine the limit of the diameter of hanks contained in bales, the manner in which these hanks shall be arranged in the bale, and the manner of labeling and tying of each entire bale.

SEC. 1784. *Supervision of grading and baling of fibers.*—Grading establishments and the grading and baling of fibers

shall be subject to the supervision of the Bureau of Agriculture; and it shall be the duty of the Director of Agriculture to provide an adequate force for the inspection and supervision of such places and processes.

The chief of the fiber division of the Bureau of Agriculture shall be chief fiber inspector, and shall receive compensation therefor in addition to his salary of not to exceed two thousand pesos per annum.

SEC. 1785. *Distribution and duties of fiber inspectors.*—One or more fiber inspectors, and such number of assistants as may be required, shall be stationed at each export port and at such other grading stations as the Director of Agriculture may deem necessary, upon the request of the party or parties concerned. The duty of such inspectors shall be to make a periodical inspection of all grading establishments within their jurisdiction; to inspect all graded and baled fibers within the purview of this law, which are intended for export; to collect all fees of inspection; and to issue to the shipper or owner of the fiber a certificate or certificates to be known as "certificates of inspection" which shall set forth the result of his inspection by showing the total number of bales inspected by him for each shipper or owner, the number of such bales of each grade and mark (if any), and such other additional data as may be stipulated by the Director of Agriculture.

SEC. 1786. *Detail of fiber inspectors for instruction of producers.*—The Director of Agriculture shall, from time to time, and as the conditions of the service permit, detail fiber inspectors for educational work among the fiber producers of the Islands. It shall be the duty of such inspectors to instruct the producers as to the manner in which they should prepare their product so as to meet the requirements of this article, and to give them such other information as will enable them to understand the grade or grades of fibers they prepare and the current prices therefor.

SEC. 1787. *Grading, baling, and inspection of fibers.*—All fibers of which the official standards shall have been established as hereinabove contemplated shall be graded, baled, inspected, approved, and certified as in this law provided.

SEC. 1788. *General requirement as to grading and certification of fibers.*—No fiber within the purview of this article shall be exported from the Philippine Islands in quantity greater than the amount sufficient to make one bale, without being

graded, baled, inspected, and certified as in this law provided; and subject to the same limitation as to amount, no fiber shall be shipped by any grading establishment at any place in the Philippine Islands where an available fiber inspector is located to any other port in the Islands without compliance with the same requirements, except upon written permission of the Director of Agriculture.

SEC. 1789. *Notice to be given to fiber inspectors.*—A grading establishment shall give the fiber inspector four days' notice in writing when practicable, stating the number of bales ready or inspection, and, when practicable, the name of the steamer on which same is to be shipped, and the destination of the shipment.

SEC. 1790. *Place and manner of inspecting fibers.*—Inspections shall be made in the regular grading shed, where one bale of every twenty, and such additional bales as the inspector shall deem necessary, shall be opened and thoroughly examined. In case of the receipt of a shipment of fiber which has been graded and baled but not inspected, inspection of any such shipment shall be made at such place as he may designate, and the owner of such fiber shall provide for the transportation of the bales to be inspected to and from the place of inspection.

It shall be the duty of the fiber inspector to determine whether or not the grade inspected conforms with the official standard for the same, whether or not the private mark (if any) used is correct, and whether the baling and labeling is in conformity with law and the lawful orders or regulations of the Bureau of Agriculture.

SEC. 1791. *Inspection of premises of grading establishment.*—The fiber inspector or other person acting under his authority shall have free access to the grading and baling sheds; and also to the warehouses where the bales are stored, of any grading establishment within his jurisdiction, during working hours, to make an inspection, for the purpose of satisfying himself as to the propriety of the methods used therein. He shall also see that the approved set of official standards is always carefully preserved and renewed within the specified period.

SEC. 1792. *Certification of inspected fibers.*—Every shipment of graded and baled abaca, maguey, or sisal, which has been inspected and approved, shall be accompanied by a certificate or certificates of inspection attached to the bill of lading and duly signed by the fiber inspector who made the inspection. All certificates of grading shall be prepared in quadruplicate, the

original and one copy to be given the owner, one copy to be forwarded to the Director of Agriculture, and one copy to be filed in the inspector's office.

SEC. 1793. *Transfer of certificate to new owner.—Issuance of secondary certificate.*—When a lot of fiber, which has been graded, baled and duly inspected and approved, is transferred by sale or otherwise from one owner to another, the certificate of inspection shall accompany the lot and the transfer of ownership noted therein by the fiber inspector in the locality where the transfer has taken place. If, however, a new certificate is desired by the purchaser, the same shall be issued to him by the local fiber inspector. Such certificate, however, shall be known as "secondary certificate of inspection."

SEC. 1794. *Second inspection of fiber shipped from port to port.*—Fiber which has been duly inspected, graded, baled, and shipped from one port to another in the Philippine Islands shall not be subject to further inspection at the port of destination, except upon written complaint received by the chief fiber inspector, providing that during transit the bales shall not have been exposed to moisture or any other agency which is likely to impair their quality.

SEC. 1795. *Inspection fee.*—Ten centavos shall be charged and collected by the appropriate fiber inspector for each bale of fiber inspected and stamped by him, whether approved or rejected. Such charges shall be paid by the owner of the fiber and receipt therefor shall be given him.

SEC. 1796. *Refund of inspection fee upon fibers used in local manufactures.*—Any person purchasing graded, baled, and inspected fiber for manufacture in the Philippine Islands into yarn, twine, rope, or other articles shall be refunded the inspection fee hereinbefore provided for upon presentation to the Director of Agricuuture of the certificate of inspection covering the number of bales consumed in such manufacture, together with an affidavit that said number of bales has actually been consumed in such manufacture with in the Islands.

PART VI

PENALTY

[Administrative Code: Article XV, Chapter 66, Title XII, Book IV]

SECTION 2748. *Violation of provisions relative to grading of fibers.*—Any person who shall change, obliterate, or counterfeit, wholly or in part, or cause to be changed, obliterated, or counter-

feited, the official or private mark or brand on any bale of fiber which has been inspected, graded, and stamped as provided in sections one thousand seven hundred and seventy one to one thousand seven hundred and ninety-six, inclusive, of this Code or who shall use any tag or mark which is not in accordance with the provisions of said article or the authorized orders of the Director of Agriculture, or who shall tamper with or alter the quantity or quality of any bale of fiber which has been so inspected, graded, graded, and stamped, or who shall otherwise violate any of the provisions of said sections shall be punished by a fine of not more than three hundred pesos; and upon conviction hereunder of any person holding a grading permit, the Director of Agriculture may with the approval of the Secretary of Agriculture and Natural Resources, withdraw and cancel such permit.

PART VII

EXECUTIVE ORDER No. 60

[Creating the Fiber Advisory Board]

MANILA, *October 26, 1922*

EXECUTIVE ORDER No. 60

A board to be known as the Fiber Advisory Board is hereby created to be composed of the Chief of the Fiber Division of the Bureau of Agriculture or his representative, as Chairman, and four members to serve without salary to be appointed from time to time by the Director of Agriculture, subject to the approval of the Secretary of Agriculture and Natural Resources, from among the Philippine fiber producers, dealers and exporters for the purpose of advising with the Director of Agriculture in settling disputes arising from the classification, grading and baling of Philippine fibers as required under Act No. 2380.

The Director of Agriculture is hereby directed to amend, subject to the approval of the Secretary of Agriculture and Natural Resources, General Order No. 54 of the Bureau of Agriculture, so as to embody therein provisions regarding the creation and functions of the aforementioned board and governing the appointment of the members thereof.

(Sgd.) LEONARD WOOD
Governor-General

PART VIII

ADMINISTRATIVE ORDER No. 25

REGULATIONS GOVERNING THE APPOINTMENT OF MEMBERS OF THE FIBER ADVISORY BOARD AND THE METHODS UNDER WHICH SAID BOARD SHALL FUNCTION

MANILA, *November 13, 1922*

ADMINISTRATIVE ORDER }
No. 23 }

In compliance with the provisions of Executive Order No. 60, dated October 26, 1922, the following regulations governing the appointment and methods under which the Fiber Advisory Board shall function are promulgated.

Regulations which shall govern the appointment of members of the Fiber Advisory Board and the methods under which said Board shall function.

SECTION 1. The Director of Agriculture shall appoint, subject to the approval of the Secretary of Agriculture and Natural Resources, four members and as many alternates as are necessary from among the Philippine fiber producers, dealers, and exporters; *Provided,* That only one member or alternate shall be appointed from any one association, business firm, company or corporation located in the same port of exportation.

SEC. 2. It shall be the duty of the Board, when called upon, to render, after due deliberation, an opinion on all matters submitted to it for consideration, such as questions arising from disputed classification or grading of fibers.

SEC. 3. Any interested party may request the Director of Agriculture to submit any disputed point regarding classification or grading of fiber in which such a party may be interested, to the Board, for advice and assistance.

SEC. 4. The Board shall determine in each case the party who shall pay the cost of reclassifying and rebaling of all bales of fiber opened as samples by the Fiber Advisory Board.

SEC. 5. In the case of a lot of fiber bought or sold by a person who is a member of the Advisory Board or by a company or firm having a member on said Board, such member of the Board shall not take part in the deliberation of the question in which such person, company or firm is interested. The Director of Agriculture in such cases shall designate as many

alternates as may be necessary to take the place of the members so affected, in the discussion of the matter involved, and to complete the membership of the Board.

SEC. 6. The members of the Fiber Advisory Board shall serve as such for one year beginning from the date of their appointment, without compensation, and cannot be reappointed within six months after the expiration of their term.

SEC. 7. In case of any controversy requiring the intervention of the Board, the interested party shall give the Director of Agriculture at least 24 hours' notice in writing, stating the number of bales in each grade in the lot to be reinspected and the place in the Port of exportation where the bales are located.

(Sgd.) ADN. HERNANDEZ
Director of Agriculture

Approved:

, (Sgd.) RAFAEL CORPUS
Secretary of Agriculture and Natural Resources

ON THE IMPROVEMENT OF ABACA (*MUSA TEXTILIS* NÉE)

By NEMESIO B. MENDIOLA
Of the Bureau of Agriculture and College of Agriculture, University of the Philippines

I. INTRODUCTION

(1) *Definition of "abaca."*—In scientific literature, and in the Philippines generally, the word "abaca" is used as the name of the plant known technically as *Musa textilis* Née. Commonly in the Islands, and to some extent in commerce, both at home and abroad, "abaca" is used to designate the fiber of this plant. Popularly, however, the name for the fiber is Manila hemp and by this name it is best known in foreign countries.

(2) *Monopoly and abaca breeding.*—Abaca is a monopoly of the Philippines. According to Copeland (1911) abaca has been introduced into India, the Andamans, Borneo, German East Africa, the West Indies and Florida. As a result of these attempts at introduction, abaca plants may possibly be found in these countries. But for some reason, possibly that the countries are not suitable to abaca growing, no one of the regions is in competion with the Philippines in the industry; Manila hemp is still practically a Philippine product. One of the latest attempts at abaca introduction is into Java. The Dutch people are highly scientific and compared with the Philippines, are more advanced in their agricultural practices, and it is probable that in time, Java will grow good abaca successfully, from the cultural point of view. Whether this island country can compete with the Philippines in abaca production is a different question. According to Copeland (1911) so long as abaca is abundant in the Philippines, labor cheap, and planters are content with little or no profit, there is no fear of successful competition by other countries. In other words, low cost of production is an important factor in maintaining the monopoly and since cost of labor is bound to rise as the country becomes developed and progressive, it will be possible to maintain the monopoly only by a much more general use of stripping machines and the greater production of abaca on the same area. The last is clearly a plant breeding problem.

II. THE NEED OF IMPROVEMENT IN ABACA

(1) *Homogeneous crops for new or renovated plantations.*—Like coconut plantations, plantings of abaca may be regarded as permanent. It is then impractical to effect improvement by selection or by the use of better varieties or strains in a plantation until it is renewed. The service of breeding will be mainly in the production, for newly opened lands and for the renovation of old abaca plantations, of better varieties or strains than are obtained promiscuously from established fields. In the Albay region where replanting is practiced, old plantations may derive decided benefit from selected and improved abaca.

Plant breeding might aid established plantations to a greater extent if mature abaca plants could be used for replanting or substitution, but this is not practical. Aldaba (1921) states that an attempt to use half-matured abaca plants in replanting failed. It is likewise undesirable to use young plants, as shading by the old trees will prevent the young seedlings from proper development. This may account in part for the law yield found in the Bicol region.

It is a common observation that no single variety exists unmixed in any plantation. Dean Baker of the College of Agriculture who has traveled much throughout the Philippines has often declared, verbally, that while varieties are known under different names, hardly any one of them is pure. This condition should cause no surprise as planters are not ussually particular in choosing pure varieties, also, abaca is cross-fertilized, and the abaca seeds, the true seeds which are more or less hybrid in nature, have been used to some extent in commercial propagation. If individual abaca plantations contain a mixture of varieties, it may be conceived that they also contain different strains of these varieties.

The heterogeneity existing in different plantings no doubt contributes a number of disadvantages such as a comparatively low yield of fiber and non-uniformity. These make a low grade of product.

Since abaca plantations are as a rule not uniform, a random collection of rhyzomes, suckers or seeds for new plantations must result in an equally non-uniform field. This fact suggests very clearly the desirability of "seed" selection, using "seed" in this case to mean the young rhizomes or suckers by which abaca plant are propagated commercially. The propagation by rhyzome insures the new plant being true to the type of the parent, and thus simplifies the method of improvement. By selecting

the rhyzomes from the most hereditarily productive hills occupied by one or a few types, or strains, the new crop if not entirely pure is bound to be more uniform and productive than that of old fields.

(2) *Need of creating new and superior varieties.*—If selection does not isolate superior strains, new varieties must be created by hybridization. The abaca plant is in a way a good material for hybridization work. The following unpublished report of Mr. Vicente Aldaba, who was with the Lais Trading and Development Company in Davao for three years and is now engaged in fiber work in the College of Agriculture gives an idea of the need of new abaca varieties in the Philippines, at least for the Davao plantations.

"The number of varieties recognized by the Philippine abaca planters is more than two dozens. However, only a few of these varities are found in any one abaca plantation. The number of good varieties is small. In Davao, for example, where there are no less than eight known varities, only three are actually being planted on a big scale; these are the Tangongon, the Maguindanao, and the Bongolanon. The main reason for the unpopularity of the other varieties is the fine weak fiber which they produce which with the present system of extracting, means a low yield. The three varieties named have stronger fiber, which allows the extraction of a larger amount of material.

"Each of these three varieties has good qualities not found in the other two. If all the good qualities of the three varieties could be combined into one variety, that variety would certainly be welcomed. To produce a variety which possesses all or most of the good qualities of the best varieties, would be worth all the effort needed to bring it into existence.

"While each of the three varieties named is at present cultivated at a profit, none of them meets all the requirements of practical farming.

"The Tangongon, the most hardy of these varieties, possesses the following strong points; it grows in heavy clay soil, is comparatively resistant to drought, the fiber is strong and heavy. But it is too hard to strip, the fiber is coarse, and it does not stool well. If a variety which strips easily, with finer fiber, and stools well, like either the Maguindanao or the Bongolanon, could be produced, then those places where the soil is heavy and where the Tangongon is the favorite, would have a variety that would meet the requirements of the natural conditions and also of the planter.

"The Maguindanao is a more desirable variety than the Tangongon so far as the requirements of the planter are concerned. It produces a soft white fiber, yields fairly well and is not so hard to strip. But it is too exacting in its soil requirement. While Tangongon grows well in soil ranging from sandy loam to heavy clay, the Maguindanao will thrive well only in light clay loam, thus its cultivation is limited to those places favored with such soil. It suffers considerably from dry weather. Its extensive evaporating surface and the scanty root system is very probably the reason for this. The poor root system is also responsible for the falling down on the ground of the stalks which very often happens with no other apparent reason than that the roots are unable to anchor down the big heavy stalks and leaves. Also it is probably the poor root system of this variety that limits its cultivation. Whatever the reason may be it remains a desideratum to discover or produce a variety with the good points of Maguindanao and the hardiness and adaptability of Tangongon.

"In places in Davao where Maguindanao and Bongolanon are extensively cultivated, the latter is rapidly replacing the former because of the many points of superiority of Bongolanon over the Maguindanao. The most important advantage of the Bongolanon is that it comes to bearing in two years, and on favorable soil namely, sandy loam, and with a little extra care it can be made to come to bearing still earlier, whereas the Maguindanao does not come to bearing under about three years. The earliness in bearing means a great saving in weeding and early financial returns. Bongolanon strips easier than the Maguindanao and consequently it costs less to produce the fiber. For instance, in working a large striping gang in a good stand of Maguindanao the average produce is eleven kilograms of wet excellently cleaned fiber. In a field of Bongolanon of as good a stand the average is thirteen kilograms. Bongolanon grows on a greater range of soil than the Maguindanao and is more resistant to drought. It is not subject to falling down on the ground as is the Maguindanao. It stools better, which partially accounts for the less amount of grass found in the Bongolanon field. But the Bongolanon variety has one serious defect. After about the fifth or sixth year its yield begins to decline. At the age of about ten years when the Maguindanao still has a fairly good stand, the Bongolanon is poor, the stalks are small and comparatively short which of course means greater cost of extraction. This rapid decline is

probably due to its very heavy stooling. At the age of four or five years the inside of the Bongolanon field is so dark as to give very little change for the development of the young suckers. In this connection it must be understood that the yield of an abaca field assumes that of a curve beginning at a low point at the age of two or three years, according to variety, rising very rapidly through the fourth, fifth, and sixth years when it begins to decline until about the age of 12 to 15 years when, as is the practice of some planters, the whole field is cut down and all the stalks of suitable size are stripped to give place for a new crop.

"While the Bongolanon grows on a wider range of soil and is more resistant to dry weather than the Maguindanao, in these two qualities it is behind the Tangongon.

"The foregoing general considerations of the three principal varieties cultivated in the region around the Gulf of Davao demonstrate clearly that no one variety answers the requirements of an ideal variety, namely, resistance to drought, adaptability to different types of soil, high yield of easily stripped fiber of good quality, earliness of bearing, and long bearing life. The Tangongon meets admirably the first two requirements, the Maguindano, the third and last, and the Bongolanon the third and fourth. There is, then, a need of creating a varitety which combines all the desirable qualities of even one or more varieties that combines in each more of these qualities than is now found in any one of the popular kinds."

That the need of better varieties is not confined to Davao but is felt in other abaca regions, also was indicated in a resolution presented by Mr. Miguel Malvar, of Batangas, in the Agricultural Conferences at the Carnival held in Manila in 1910. In the resolution the Bureau of Agriculture was requested to "distribute seed of the best varieties of abaca to the hemp growers of the Philippines so that the poorer varieties which are grown in many plantations can be destroyed and the better varieties planted." [h]

III. POSSIBILITIES OF IMPROVEMENT

Aside from the general observation that abaca varieties in the Philippines exist in a heterogeneous condition, absolutely nothing is known about the amount of variability which may be found and on which improvement in the isolation of superior strains would be based. Investigations along this line are ur-

[1] Philippine Agricultural Review 3: 390–391. 1910.

gently needed. There is no doubt that even if abaca is propagated vegetatively, and for this reason, a field might contain fewer hereditary strains or biotypes than if it were propagated sexually, improvemetnt should be possible by hill selection just as stool selection has given improvement in sugar cane.

Of greater possibility than immediate selection is the production of new seedling varieties by seed propagation followed by selection. In sexual reproduction, the abaca is cross-pollinated. It is to be assumed, therefore, that there are in existence to-day natural abaca hybrids in different degrees of heterozygosity. Propagation by vegetative parts has maintained this heterozygosity and it should be possible by self-fertilization and seed propagation to produce various seedling types from which new varieties may be selected. The possibility in this direction has not been fully demonstrated. However, there are evidences that show that such a possibility exists, at least so far as the production of a working variability is concerned.

The first evidence is a result of a study by the Bureau of Agriculture of the possibility of producing young plants from the true seeds of the abaca for commercial "seed" purposes, to partly meet the demand for suckers. The following is an account of the experiment which is quoted for its historical interest in connection with abaca breeding.[2]

"The growing of abaca in commercial quantities from seed has an important bearing on the industry on account of the limited supply of abaca suckers in certain provinces. In Mindanao some planters report the demand so great that they are finding it more profitable to sell abaca suckers at prevailing prices than to grow the plants for fiber. Of three lots of seed obtained the past year, two large lots proved defective, less than one per cent germinating. From a small (150 grams) sample, the very good germination of 60 per cent was obtained. The high winds of the dry season scorched and killed off many of the young plants, but 700 survived, were twice transplanted, and then sent to the Lamao station in Bataan for permanent planting. At the time of removal the stems of these seedlings averaged 3 feet 6 inches in height and were correspondingly stocky and vigorous. The seeds were planted October 14, 1906, and the plants set out permanently June 1 of the present year, thus demonstrating that abaca plants may be obtained from

---

[2] Growing abaca from seed. The Philippine Agricultural Review 1: 27–27. 1908.

seed in seven and one-half months. Some plants that were slightly protected were of suitable size for permanent planting inside of six months from time of seed sowing. The soil and climatic conditions in Manila where these experiments were conducted were exceptionally bad and there is no doubt that under favorable conditions the results, including germination, would be much more satisfactory. The procuring of seed is sometimes a matter of much difficulty, as abaca plants are usually cut before the seed matures. Planters who desire to follow this method of propagation can do so by reserving a few fully mature stools of the plant which will produce all the seed required."

After repeated observations and experiments, it was found that it is not advisable [1] to use abaca seeds for propagation. Mr. Don D. Strong, a fiber specialist of the Bureau of Agriculture addressing the farmers on this topic gave as the reasons [2]: (1) That the seeds are "hard to obtain, hard to separate from the fruit, great care is needed to get them to germinate properly and two plantings are necessary before the plants are sufficiently developed for field planting. (2) That varieties from seed do not come true to name and plants from seed usually taken from one to two years longer to mature than plants propagated from shoots or root stocks."

From the viewpoint of abaca breeding the most important of these reasons is the one pertaining to the abaca seedlings not coming true to type of the parent. This fact suggests at once the possibility of producing new varieties.

The College of Agriculture initiated the growing of seedling abaca for the production of new varieties. The first step did not go beyond the demonstration of variability among young seedling plants. Table I contains the result of this work. The seeds were furnished by Mr. Tomas Vista, formerly in charge of fiber work in this College, and were Boac variety. The seeds came from one plant only. Table I shows that great variability exists in abaca seedlings from even one parent plant. This variability involves such important characters as vigor and height of the plant, diameter of stalk, habit of stooling, and number of stalks to the stool.

---

[1] Eighteenth Annual Report of the Director of Agriculture. The Philippine Agriculture Review 12: 1–68. 1919.

[2] Abaca Pointers. The Philippine Farmer 4: 33–33. 1918.

TABLE I.—*Variation of abaca plants grown from seed, 1919–1920*

Plant No.	Root		Height of plant	Diameter of stalk		General vigor of plant		Leaves	Size of largest leaf		Stooling		Other characters
	Number	Length of longest root		Uppermost	Bottom		Number	Coloration	Length	Breath	Habit	Number of stools	
		cm.	*cm.*	*cm.*	*cm.*				*cm.*	*cm.*			
1	84	39.0	150.5	4.0	8.2	vigorous	14	deep green	76	36	spreading	4	Midribs purple.
2	25	23.3	73.0	2.0	4.0	stunted	9	deep green	40	15	compact	2	Midribs purple.
3	31	34.3	78.0	2.5	5.0	stunted	9	green	43	17	compact	1	
4	55	43.0	129.0	5.0	7.0	diseased	10	pale green	65	17	spreading	4	
5	54	40.0	144.0	4.0	7.5	vigorous	10	deep green	73	29	spreading	2	Midribs purple.
6	75	34.6	153.5	3.0	7.0	vigorous	11	deep green	75	30	spreading	7	
7	51	40.0	90.0	3.5	5.0	ordinary	10	green	58	26		1	
8	51	41.0	121.0	4.5	6.0	vigorous	7	green	65	30		1	Midribs purple.
9	33	42.0	58.9	1.8	3.5	stunted	10	green	37	15		1	Midribs purple.
10	37	32.5	100.0	2.5	5.0	vigorous	12	green	56	27		1	Lower leaf surface purple.
11	20	34.9	55.0	2.5	4.0	stunted	10	light green	24	13		1	Lower leaf surface purple.
12	22	26.4	50.0	1.5	2.7	stunted	10	light green	31	13		1	
13	32	35.5	70.5	2.5	4.5	stunted	15	light green	44	19		1	Upper surface purple.
14	67	51.0	139.0	3.5	6.0	vigorous	10	green	84	29	spreading	6	
15	52	42.5	154.0	3.5	6.2	vigorous	10	deep green	86	33	spreading	3	
16	45	40.5	99.0	2.8	4.8	ordinary	9	light green	56	22	spreading	2	Leaves surface purple.
17	43	34.5	100.0	4.5	6.5	vigorous	8	green	60	27	compact	7	Lower surface purple.
18	85	39.0	146.0	3.0	7.0	vigorous	8	green	82	33		1	Midribs purple.
19	37	41.0	74.5	2.3	5.5	stunted	10	green	42	20		1	Midribs purple.
20	45	40.0	96.0	3.5	6.0	vigorous	10	green	57	30		1	Lower surface purple.
21	25	45.0	68.0	2.0	3.5	fair	8	green	37	16	spreading	4	
22	42	36.0	131.0	3.5	7.5	vigorous	11	light green	76	32		1	Diseased.
23	(a)	(a)	26.0	1.5	2.5	stunted	9	green	16	7		1	
24	33	27.0	86.0	3.5	4.5	fair	10	green	51	20	spreading	4	Lower surface light purple.
25	31	38.0	97.5	4.0	6.5	vigorous	11	light green	55	28		1	Lower surface light purple.
26	14	17.5	21.0	1.2	2.0	stunted	8	light green	16	5	compact	2	
27	49	36.0	63.0	2.5	4.0	stunted	10	light green	39	17		1	
28	30	27.2	64.0	3.5	6.5	fair	7	green	37	18	spreading	7	
29	41	35.0	103.0	3.0	4.0	vigorous	10	light green	63	35		1	
30	37	40.4	40.0	3.5	5.0	stunted	8	light green	26	11	spreading	2	
31	53	31.5	108.5	3.5	5.0	vigorous	10	green	61	28	spreading	2	
32	57	36.5	109.5	2.5	5.9	vigorous	9	green	61	24	spreading	6	
33	28	32.0	56.0	2.5	3.2	stunted	8	light green	33	13		1	

[a] Dead.

IV. HOW TO IMPROVE THE ABACA

(1) *Characteristics of abaca desired.*—Before discussing the methods that may be employed in abaca improvement, it is well to study what characteristics are considered desirable in a variety or strain. The desired characteristics are:

(*a*) Those pertaining to the plant as a whole.
Yield in fiber.
Suitability to environmental conditions.
Resistance to drought.
Stooling habit.
Adaptability to stripping.
Diameter and length of stalk
Habit of falling down.
Age of bearing.
Length of bearing season.

(*b*) Those pertaining to the fiber.
Texture.
Strength.
Color.
Length.

In general, the aim will be a variety that gives a high yield of fiber; is resistant to drought; stools well but not to the extent of involving a sacrifice of long and large stalks and long bearing season; is easy to strip; has large and long stalks; is not subject to falling down on account, possibly, of poor root system; bears easily; and has a comparatively long bearing life.

In fiber, the aim is to produce fiber which is strong, fine, white and not short. The way fibers are classified, or graded in the market at present (Saleeby, 1918), does not take strength into consideration. Undoubtedly this is a defect which will have to be remedied when our varieties become more uniform and their characteristic fiber strength known.

(2) *Methods of improvement.*—It is believed that improvement of the abaca plant will consist in the following methods: (*a*) tests and elimination of undesirable varieties found in each region, (*b*) tests and use in one region of varieties grown in others, (*c*) "seed" selection, (*d*) production of new superior varieties by artificial hybridization and (*e*) production of new superior seedling varieties without artificial hybridization.

(*a*) *Tests and elimination of varieties found in the region.*—Different men have set the number of distinct varieties of abaca in the Philippines at from fourteen to about seventy. The exact number will never be known until a careful study of varieties is

made from both the botanical and the agronomical standpoint. A beginning in this line has been made in the College of Agricuture by Mr. Tomas Vista [1] formerly in charge of fiber work.

In starting a new plantation or even in renovating old plantations or hills, a planter should use such seed material as come from varieties of good standing in the region. If it is not known yet what these varieties are, it will pay him in the long run to carry out careful variety tests. The size and appearance alone of the plants is not an index of the variety's value. Edwards and Saleeby (1910) state that inexperienced planters have sustained considerable losses by making a mistake in using undesirable varieties which are attractive only on account of their large plants and excellent appearance. The test of varieties should cover observations from planting to the time of renovation and take into consideration the desirable characteristics of a variety.

In performing variety tests of abaca there are special precautions which should be taken and which are more important in the case of this plant than in others propagated always by true seeds. These precautions refer to the age of vegetative material used and the number of young plants used to the hill.

In the first place, it is not proper to use, in variety tests, the true seeds of abaca. Only suckers alone or root stocks alone should be used, but not both. If suckers are used, it is easy to see that the same number of individuals is planted in a hill. If root stocks are used, a large error may creep in the test by using section of roots containing different numbers of "eyes" or vegetative buds. The same number of "eyes" should be planted in a hill.

(*b*) *Tests and use in one region of varieties grown in others.*—It is already known that varieties vary in their behavior in different regions. To what extent they do this is not known. Hence it is necessary that tests be made in one region of varieties found in others. If superior varieties may be discovered for different localities in this way, there may be no immediate necessity of producing or seeking new seedling varieties.

(*c*) *Seed selection.*—The term "seed" in this case refers to vegetative parts, such as suckers and rootstocks, which are used for propagation and does not refer to the true seed of the abaca plant. "Seed" selection may be done in old or already established plantations, or, preferably, in plantations to be planted

[1] VISTA, T. I. A study on the classification of abaca varieties. (Unpublished.)

for "seed" selection purposes. "Seed" should be selected from the most desirable parent plants or hills. To tell which plants or hills are desirable and which are not, proper comparison has to be made of different plants.

As plantations are ordinarily planted and harvested, they are not in condition to allow a fair comparison of the different mother plants. It is likely that in the initial planting, different numbers of young plants were used for "seed" in each hill; replantings have probably been made in a number of hills and it is difficult to tell which hills were so replanted; after the first two or three years of bearing, young plants have already been killed in different hills and the number killed may not be the same in each hill.

If there is a plantation in which the individual hills have been planted, treated, and otherwise managed uniformly, these hills may be used for "seed" selection. Mr. Aldaba of the Fiber Division in the College of Agriculture believes that the number of bearing stalks harvested each gathering season is a fair index of the yield of the different hills. Accordingly, "seeds" may be selected from those hills which produced each season the greatest number of stalks which are ready for stripping. More accurate choice of "seed" hills may be made if, besides in yield, the different hills are studied and compared in the other important characteristics of the plant.

If there are no plantations which are suitable for "seed" selection work, this can not be done unless new plantings are made for this purpose. These should be preferably in plant or hill-to-the-row system. In about from three to five years, depending upon the variety, comparative studies of the different lines, or clons, may be made and the best mother hills selected. Vegetative propagation in abaca does away with undersirable effects of cross-pollination on selection work. There is no detasseling to be made or bagging or screening to be performed. The fact that once a plant is established in its hill it produces a continuous supply of "seed" material also simplifies selection work as there need not be yearly plantings of selected "seeds" unless those already planted are not sufficient in number to produce the amount of "seed" in demand.

Both mass and line selection methods may be used in abaca. Mass selection in abaca will reach its limit of usefulness, that is, will produce the same result as line selection, in a shorter time than in corn or in sugar cane because a greater number of individual "seeds" may be obtained from an abaca stool

than from a sugar cane stool, and, as compared with corn, commercial abaca propagation is not affected by cross-pollination.

(*d*) *Production of new superior seedling varieties without artificial hybridization.*—In general, this method is similar to that used for sugar cane. It consists, briefly, in planting the true seeds of the plant, testing the seedling plants to come from the seeds, and selecting the most desirable varieties so produced.

As has been mentioned elsewhere, abaca is cross-pollinated and so the true seeds and the plants from these are hybrids. It is no wonder the seedlings are found not to come true to type even if there is no artificial hybridization made.

The following directions in the handling of abaca seeds are recommended:

Handle seeds of different varieties separately.

Gather the seeds from the most desirable varieties, hills or plants. If these are usually harvested before the fruits ripen, plants should be saved at harvesting and set aside for seed purposes.

Seeds should be taken only from ripe abaca fruits.

After separating the seeds from the pulp, any trace of it remaining should be removed by thorough washing. After the seeds are cleaned they should then be dried in the sun and kept in a suitable container until they are planted.

Before planting, seeds which float in the water should be eliminated. To hasten germination those saved may be soaked in water 50° C to 60° C for ten minutes before sowing.

The seeds may be sown in ordinary seed flats containing sterilized soil. Sowing is done as with other seeds, by placing them below the surface of the soil, not as in the case of sugar cane where the seeds are placed only on the surface of the soil and a glass or cloth is used as cover to maintain a moist condition on the surface of the soil. In abaca, it is sufficient that the soil in the box be kept moist, not wet, and the seed box exposed most of the time to sunlight.

Seeds should germinate in from 5 to 30 days.

When the seedlings are about two centimeters high they may be transplanted, or pricked, into other boxes in which the soil is deeper. Here they are allowed to grow under partial shade until the soil in the box is too shallow for proper development of the plants, then they are transplanted to a partially shaded plot or to the permanent trial field.

In the permanent field, the plants may be planted 3.5 meters each way, using only one plant in each hill.

The seedling plants require one to two years longer time than plants grown from suckers to come into bearing.

(*e*) *Production of superior artificial hybrids.*—This method requires the extra labor used in artificial hybridization and the added inconvenience of having to begin the work at from the time the plant produces its flowers. Compared with the method of indiscriminate production of natural hybrids, artificial hybridization has the great advantage in that parent varieties may be chosen carefully before the work is performed, according to the kind of a new variety desired. In this way, success will probably be obtained in a much shorter time.

(3) *The abaca flowers and seed.*—A knowledge of some of the points about the abaca flowers and seed is essential in the improvement of abaca by the method just described.

(*a*) *The flowers.*—The inflorescence of the abaca is a spike which consists in a rachis bearing several clusters of flowers. The clusters correspond to the "hands" of the bunch of fruits. Each cluster is subtended by a large membranous bract.

In each spike there are two kinds of flowers which may be called the female and the male. The female flowers are also called the pistillate or the "true" or "real" flowers while the male, the staminate or "false" flowers. The main distinction lies in the fact that the pistillate parts of the "female flowers" are normal and functional, while in the "male flowers" the staminate parts are normal and the ovaries are not known to develop. The female flowers are in a group by themselves and occupy the basal half of the inflorescence. The male clusters are larger and longer than the female, and subtended by larger bracts also.

Abaca pollination.—So far as has been observed, abaca is naturally cross-fertilized, self-pollination seemingly impossible. By the time the male flowers in a spike shed their pollen, the stigmas of the female flowers are already withered and dry and the embryonic fruits are already in an advanced way of development. Since bagging experiments in the College of Agriculture have shown that bagged female flowers failed to produce fruits, it is more than likely that such fruits as develop and produce seeds are either partheno-genetic or are pollinated with pollen from other trees. The latter is the more probable. During the blooming period of the male flowers wasps and ants in large numbers, were observed to be regular and constant visitors. This would indicate that these are agents in pollination.

(*b*) *The seed.*—The seed of the abaca is generally small, about two or three millimeters broad, shorter than wide, and about half as wide in thickness. It is black and is produced in abundance, the number varying according to the size of the fruit, or "finger" and the variety. The number of fingers or individual fruits in a bunch varies in the abaca species from about 5 to more than 120. According to Doctor Espino of the College of Agriculture, a medium sized bunch of the Libuton variety was found to contain 7 "hands" with 7 to 12 "fingers" in a hand and a total for the entire bunch of 8,045 seeds. A certain portion of the seeds produced by each variety does not germinate. In a study of germination in eight varieties,—the Sinamoro Pute, Laguna, Imosa, Punucan Bangulanon, Libuton, Itom, and Pinoonan,—by the Division of Genetics, the percentage of germination found was as low as 10 per cent for Punucan and only as high as 68 per cent for Laguna.

The abaca seed does not germinate very readily. Under ordinary conditions, it will not germinate within less than 25 days. If soaked for 10 minutes in water 50° C to 60° C, germination may be hastened.

V. ENEMY OF THE ABACA SEEDLING

Abaca seedlings in the Plant Breeding Nursery of the College of Agriculture were observed to be attacked by the larvae of a moth which the Entomology Department identified as *Plusia eriosoma* Doubl. This species is said to attack also okra, eggplant and corn.

VI. SUMMARY

1. It is impractical to perform proper strain selection in existing ordinary abaca plantations; neither is it practical to improve such plantations by the use of better varieties or strains.

2. The main object of abaca breeding will be the production of better varieties or strains for newly opened lands and for the renovation of old plantations.

3. There is need of better varieties all over the abaca area. For the abaca region around the Gulf of Davao, there is a distinct need of a variety that would combine such important characters as (*a*) resistance to drought, (*b*) adaptability to different types of soil, (*c*) high yield of easily stripped fiber of good quality, (*d*) earliness of bearing and (*e*) a comparatively longer bearing life. The Tangongon variety possesses (*a*) and (*b*); the Maguindanao, (*c*) and (*e*); while the Bongolanon, (*c*) and (*d*).

4. Considering that abaca is cross-pollinating and that it is commercially propagated by vegetative means, it would appear that the most inviting if not the best avenue of abaca improvement is the production of superior seedling varieties, which are either natural or artificial hybrids, a method which is so successfully used with the sugar cane.

5. Abaca seeds were germinated by the Bureau of Agricuture to determine the value of seedlings for commercial propagation and it was found that it is not advisable to use abaca seeds for commercial propagation, due among other things, to the heterogeneity of the crop obtained.

6. This same heterogeneity of seedlings indicates in another direction the great possibility of producing new desirable varieties by seed germination and seedling cultures.

7. Abaca seeds germinate in 5 to 30 days depending partly on temperature condition.

VII. LITERATURE CITED

ALDABA, VICENTE C. The cultivation of abaca and preparation of its fiber in Davao. The Philippine Agriculturist 10: 273–282. 1921.

COPELAND, E. B. Abaca. The Philippine Agriculturist and Forester 11: 64–73. 1911.

EDWARDS, H. T. and SALEEBY, M. M. Abaca (Manila hemp). Bureau of Agriculture Farmers' Bulletin No. 12. 1910.

SALEEBY, M. M. Descripción de los grados clasificados como standard de Filipinas. Revista Agrícola de Filipinas 11: 1–28. 1918.

THE DETERIORATION OF ABACA FIBER

By Eladio Sablan and Mariano F. Villaraza

Abaca fiber with pulp deteriorates faster than clean fiber. This was amply demonstrated in a series of experiments with Shoppers' Testing Machine by which, by measuring the tensile strength of the fiber, the varying degrees of deterioration of the different standard grades of loose abaca fiber in a Manila bodega over a given period, from March, 1921, to March, 1922, were determined and compared.

MATERIALS AND METHODS

To start with, two sets of the standard grades of abaca fiber were used. One set was hung on the wall of a laboratory, while the other was put in a gunny sack and laid on the cement floor of a bodega (storeroom).

The temperature of the bodega was taken three times daily and its relative humidity computed according to the psychrometric table obtained from the Weather Bureau, Manila. The bodega had an average temperature of 29.36° C (dry bulb thermometer) and 26.33° (wet) and an average relative humidity of 74.35 per cent during March and also October, 1921.

EXPERIMENTS AND RESULTS

In March, 1921, when the experiment was started the tensile strength of each and all grades was tested by means of Shopper's Testing Machine. Twenty samples, of ten fibers each, of the grades were taken for this purpose. They were cut one meter long, weighed and then broken one at a time in the testing machine. The figures for the first tests are as follows:

TABLE I

Grades	Average tensile strength		Grades	Average tensile strength	
	Exposed in room	Kept in sack		Fxposed in room	Kept in sack
	Grams	*Grams*		*Grams*	*Grams*
A	54,288	54,125	G	52,820	56,541
B	54,687	54,295	H	50,681	51,342
C	55,297	54,736	I	57,889	41,049
D	53,084	59,430	J	37,245	40,210
E	58,596	50,152	K	44,902	43,454
S1	56,000	55,758	L	31,679	41,181
S2	55,010	56,546	M	39,721	51,351
S3	58,285	56,892	DL	29,742	34,175
F	54,282	60,908	DM	37,666	32,073

Six months after, October, 1921, these grades of fiber were tested again. The results are given in the following table:

TABLE II

Grades	Average tensile strength		Grades	Average tensile strength	
	Exposed in room	Kept in sack		Exposed in room	Kept in sack
	Grams	*Grams*		*Grams*	*Grams*
A	51,927	52,110	G	52,352	54,867
B	54,593	54,393	H	46,285	29,515
C	55,093	52,123	I	50,988	42,589
D	52,445	59,057	J	41,622	33,731
E	57,088	49,045	K	37,164	40,700
S1	54,441	52,256	L	21,221	24,573
S2	53,447	55,569	M	31,369	37,666
S3	57,530	55,664	DL	26,483	27,108
F	52,756	56,428	DM	26,795	31,028

DISCUSSION OF RESULTS

To simplify these data these standard grades have been grouped according to the cleaning of fiber, thus:

Group I.—Excellent cleaning: A, B, C, D, E, S1, S2, S3.

Group II.—Good cleaning: F, G, H.

Group III.—Fair cleaning: I, J, K.

Group IV.—Coarse cleaning: L, M, DL, DM.

The averages of the different groups for the two tests follow:

TABLE III

Groups	Average tensile strength		Deterioration after six months
	March, 1921	October, 1921	
	Grams	*Grams*	*Pér cent*
I	55,448	54,127	2.17
II	54,425	52,033	4.41
III	44,124	41,132	6.78
IV	35,948	29,450	18.07

From these results it is evident that the degree of cleaning of the fiber has much to do with the deterioration of the fiber in storage. The cleaner the fiber (i. e., the less pulp it has) the longer it will store with very little deterioration under ordinary conditions.

It may be pointed out that all of these grades of fiber tested appear almost exactly as when they were first tested except for a change in color and loss of luster in those that were exposed. Those in the sack showed little, if any, change in color.

On March 1, 1922, the third test of the tensile strength of the different grades of abaca was made. After the third test had been made it was found that the deterioration of the exposed fiber and that of the fiber kept in a gunny sack was almost the

same, showing that the sack did not make much difference in the way of protecting the fiber. For this reason the results obtained in the exposed fiber and those kept in a sack were combined and averaged. The table below (Table IV) shows the tensile strength of the fibers at different times and the deterioration of the same in per cent.

TABLE IV

Grades	Average tensile strength			Deterioration	
	March, 1921	October, 1921	March, 1922	Six months	Twelve months
	Grams	*Grams*	*Grams*	*Per cent*	*Per cent*
A	54,206	52,018	51,188	4.03	5.56
B	54,491	54,487	54,047	.007	.81
C	55,016	53,608	53,406	2.55	2.74
D	56,257	55,751	55,737	.89	.92
E	54,374	53,685	53,590	1.26	1.44
S1	55,879	53,350	52,687	4.52	5.71
S2	55,781	54,458	52,748	2.37	5.42
S3	57,588	56,597	53,359	1.72	7.34
F	57,595	54,592	53,932	5.21	6.36
G	54,680	53,609	51,307	1.95	6.16
H	51,011	47,900	47,022	6.09	7.82
I	49,469	46,688	46,746	5.42	5.76
J	38,727	37,676	36,547	2.71	5.63
K	44,178	38,932	39,004	11.87	11.71
L	36,430	22,897	33,125	37.15	9.07
M	40,536	34,518	38,920	14.84	3.98
DL	31,958	26,795	24,397	16.15	23.63
DM	34,869	33,593	32,372	3.65	7.16

During the period from November, 1921, to March, 1922, the abaca samples were kept in the same room, the average temperature of which fell to 80.259° F (23.03° C) and the average relative humidity to 62.692 per cent. The temperature and relative humidity at this time were determined by means of Tycos Hygrometer and Slign Psychrometer.

Again, adding together these results and averaging them in groups according to the degree of cleaning of the fibers we have the following table showing the deterioration of the fiber of each group:

TABLE V

Groups	Comparative tensile strength			Deterioration	
	March, 1921	October, 1921	March, 1922	Six months	Twelve months
	Grams	*Grams*	*Grams*	*Per cent*	*Per cent*
I	55,449.00	54,244.25	53,345.25	2.17	3.79
II	54,428.66	52,033.66	50,753.66	4.41	6.75
III	44,124.66	41,132.00	40,765.66	6.78	7.61
IV	35,948.25	29,450.75	32,203.50	18.07	10.41

SUMMARY OF CONCLUSIONS

The foregoing table clearly shows that the deterioration of the fibers of different cleaning found in the second test, follow

almost the same tendency as that of the first tests, except that the percentage of deterioration of the fibers in Group IV after a year is less than that of the first six months. This seeming inconsistency may be explained in part by the fact that, as these tests are based on weights of the materials, the coarse fibers containing pulp naturally absorb more moisture. Thus, these fibers in Group IV during the third period of test, from November, 1921, to March, 1922, when the percentage of humidity fell to 62.69 per cent, appear to show much smaller deterioration than during the wet season. King[1] states that "wetting has a marked influence upon and generally causes a slight decrease in the tensile strength of most bast ropes." It follows therefore that during the dry season the fibers in Group IV by losing in weight would show less percentage of deterioration than the preceding wet months.

[1] KING, A. E. W. The Mechanical Properties of Philippine Bast Fiber Ropes. Philippine Journal of Science, Vol. XIV, No. 6, June, 1919.

196418——4

BANANA WILT AND THE MANILA HEMP PLANT

By H. ATHERTON LEE AND F. B. SERRANO

Manila hemp is regarded among fiber men as unequaled among plant fibers for the manufacture of high grade cordage such as that used for marine and fishing purposes. It is obtained by a stripping process from a plant, *Musa textilis* Née., closely resembling the banana in appearance. Its production is confined to the Philippine Islands and the plant has never been successfully cultivated in any other country for commercial ends. The Philippines therefore hold a monopoly on the production of this very superior plant fiber.

It goes without saying then that it is the paramount duty of every hemp grower to maintain this natural monopoly. This can be done only by improving the plantations and as a means to that end the best methods of controlling the diseases that affect the hemp must be carefully studied.

The object of this article is to describe a disease of the Manila hemp plant commonly known as banana wilt. This disease was described in 1915 by Reinking [1] as abaca [2] heart rot and its cause was ascribed to bacteria, the identity of which were undetermined. More recently this disease has grown in seriousness and commercial growers requested that investigations be made. The distribution of the disease was first determined and found to be destructive as yet only in the provinces of Laguna and Cavite.

Isolation and inoculation studies were undertaken with the expectation of corroborating earlier results. Bacteria were found in isolation studies, commonly associated with advanced stages of the disease, although an imperfect fungus was almost as uniformly isolated. As the disease became familiar it was possible to find less advanced pathological stages, and from such earlier stages, an imperfect fungus, a *Fusarium,* was obtained in a very high percentage of cases. Examination of fresh frozen sections and of serial parafin sections

---

[1] REINKING, OTTO A. Philippine Economic Plant Diseases. Philippine Journal of Science, Sec. A, Vol. XIII.

[2] Abaca is the dialect word in the Philippines for the Manila hemp plant.

showed with little or no difficulty, presence of fungus hyphae in the early advancing stages of the disease. Isolations were continued repeatedly, in all 1468 isolations being made. After the first four series of isolations, *Fusarium* began to appear and thereafter appeared in 60.44 per cent of the plantings. Few fungi of other genera appeared in such plantings. The bacteria isolated in the older stages did not appear uniformly although three different forms of colonies on beef agar plates appeared more frequently than others.

The isolation trials thus having reached this stage, inoculation experiments were tried. The bacterial species for convenience were termed organisms A, B, and C. Since the bacterial species ascribed as the cause of the disease by Reinking was not described, its identity with any one of these three organisms could not be determined. Inoculation studies have been made with all three of the bacterial species and with the *Fusarium*. Inoculations were made with needle punctures, through the pseudostem into the central cylinder. Table 1 shows the number of such inoculations and results.

TABLE 1.—*Showing results of inoculations into the central cylinders of the Manila hemp plant, with various organisms isolated from heart rot cases and with sterile needles as controls.*

	Number of inoculations	Positive heart rot cases resulting	Percentage positive heart rot results
Organism A	20	1	5.00
Organism B	80	8	10.00
Organism C	145	9	6.20
Sterile needle through sterile external surface	70	4	5.71
Hemp plant *Fusarium*	199	96	[a]48.24

[a] As the technique was improved, positive results were obtained with the hemp plant *Fusarium* in 89 out of 134 attempts or 66.41 per cent. Failure to obtain 100 per cent positive results possibly may be correlated with the improbability of placing the inoculum, through the thick resistant pseudostem into the susceptible central cylinder tissues in every inoculation attempt.

It seemed apparent to us, therefore, that the *Fusarium* species was a pathogene.

Studies were then taken up to identify this *Fusarium* species. It so happened that we had recently isolated *Fusarium cubense* Erw. F. Smith, from banana wilt cases in the Philippines and the hemp plant fungus was being culture at the same time. Comparisons were naturally made of morphological and cultural characters and it was found impossible to distinguish the fungi from each other.

In earlier studies the banana wilt fungus inoculated into banana plants caused blackened discolored rhizomes, splitting

of the pseudostem and yellowing and dying of the leaves. The same organism inoculated with the same technique into the pseudostems of Manila hemp plants could not cause such lesions and the hemp plant was at the time considered resistant.[3]

Now, with morphological and cultural similarity very great between the banana wilt *Fusarium* and Manila hemp *Fusarium*, inoculations were made with needle punctures, thru the thick pseudostem, into the central cylinder of Manila hemp plants with the banana wilt *Fusarium*, with control inoculations with the Manila hemp plant *Fusarium*. The results are shown in Table 2.

TABLE 2.—*Showing results of inoculating Manila hemp plants with Fusarium cubense Erw. F. Smith, and with the Fusarium from the hemp plant heart rot.*

	Number of inoculations	Positive cases resulting	Percentage positive cases
Hemp plant *Fusarium*	134	89	66.41
Banana wilt *Fusarium*	115	65	56.52

Since the morphological and physiological characters of the hemp plant pathogene seem to be similar to those of the banana wilt organism, *Fusarium cubense*, the two must be considered for the present at least, as of the same species.

The conclusions moreover are, that *Fusarium cubense* cannot produce banana wilt symptoms upon the Manila hemp plant, but that inoculated with the proper technique to introduce it into the growing central cylinder of the hemp plant, it can produce typical heart rot. The interesting situation is developed of a fungus species producing one set of symptoms on one host plant, and an entirely different set of symptoms on another host plant.

Only two banana plants have been inoculated with the Manila hemp *Fusarium*, but both such plants have given banana wilt symptoms probably more promptly and virulently than *Fusarium cubense* direct from banana wilt. A control inoculation without any fungus remained negative.

Our knowledge of heart rot of the Manila hemp plant is therefore greatly increased since, from the work of Brandes,[4] it is known that *Fusarium cubense* is not a strict parasite, but

[3] Lee, H. Atherton and Serrano, F. B. Banana Wilt in the Philippines, Phytopathology, Vol. X, No. 11, November, 1920.

[4] BRANDES, E. W. Banana Wilt. Phytopathology Vol. XI, No. 9, September, 1919, p. 339.

can exist in the soil and that infection can take place through the soil. The discovery of this phase leads also to an understanding of heart rot of the hemp plant as possibly becoming just as destructive and steadily advancing as is banana wilt in the West Indies.

Our present efforts for the control of the disease seem to be most promising along the lines of varieties which may be found to be resistant. A more detailed report will appear in the Philippine Journal of Science.

MAURITIUS HEMP, (*FURCROEA GIGANTEA*), WITH REFERENCE TO ITS INFERIORITY TO ABACA, MAGUEY, AND SISAL *

By R. B. ESPINO AND T. NOVERO
Of the College of Agriculture

NOMENCLATURE AND DISTRIBUTION

Matthews [1] seems to think that Mauritius hemp is synonymous with "Aloe Fiber" and as he says "is obtained from the leaf of various species of aloe plants growing in tropical climates." The same author said, "the principal plant employed for Mauritius fiber is *Furcroea feotida.*" In separate papers he and Dodge [2] report that Giant Lily is the common or popular name for *Furcroea gigantea.* However, Dodge agrees with Macmillan [3] that the fiber obtained from this species of *Furcroea* is known commercialy as Mauritius hemp.

Other native and common names of this plant are reported by Dodge. In Central America and the West Indies the plant is locally known as *Cabouya* or *Cabuja; Cocuiza* and *Fique* are its name in Venezuela. In Costa Rica the plant is known as *Pita* and *Pita floja; Peteria* in Brazil; *aloes vert* and *foetid aloe* in Mauritius; and *giant fiber lily* is its name in Australia. In the Philippines the plant is known as Mauritius hemp or "century plant." There is no native name for it.

The wide distribution of this plant is well indicated by the the names it has received from different places. According to Dodge the Mauritius hemp is a native of tropical America. The plant is supposed to have been introduced from South America to Mauritius about 1790. It now grows in Algeria, Natal and St. Helena. Likewise, India, Ceylon, and Australia grow it. In the Philippines the Mauritius hemp is grown at the back of yards serving as a fence or for ornamental purposes. The plant has been grown at the College of Agriculture at Los

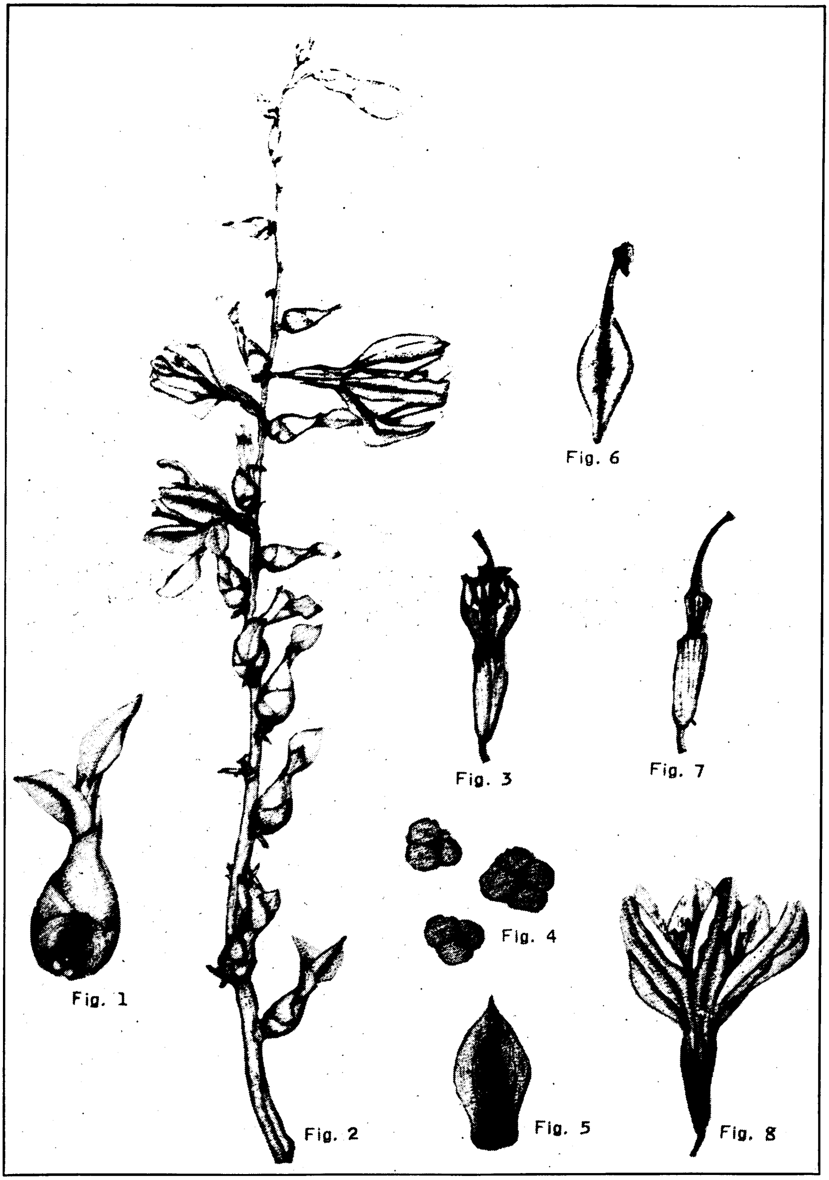
---

* Experiment Station Contribution No. 126.

[1] MATTHEWS, J. M. The textile fibers. New York: John Wiley and Sons, p. 480 1908.

[2] DODGE, C. R. Useful fiber plants of the world. United States Department of Agriculture Report No. 9, p. 361 1897.

[3] MACMILLAN, H. F. Mauritius hemp. Tropical Agriculturist 40: (No. 4) 1–208. 1913.



Bulbils and flower structures—Fig. 1. A bulbil; Fig. 2. A branch with bulbils on at the axil of flowers; Fig. 3. A flower, petals removed; Fig. 4. Pollen grains; Fig. 5. A petal; Fig. 6. A stamen; Fig. 7. A pistil; and Fig. 8. A complete flower.

Baños since about the early days of the college, as an ornamental plant and latter on in trial plots.

The present report covers the preliminary harvest made of this plant and studies on the qualities of its fiber.

THE PLANT AND ITS YIELD OF FIBER

As Macmillan describes it, Mauritius hemp "is a large succulent, stemless perennial, bearing long fleshy leaves which radiate from the base." Up to the formation of a central "pole" and when grown at the College of Agriculture, Los Baños, the plant produced from 54 to as many as 88 leaves whose fiber content could be extracted. About 5 to 10 older ones in each plant are not included. They were either too short to ret for the tip ends were decaying or they were dried up or completely rotted. Probably a plant may produce as many as 100 leaves. This however, is true only in cases of rather extraordinary big ones.

Unlike species of Agave, the Mauritius hemp does not produce many suckers at the side of the mother plant. It could not, therefore, be well or rapidly reproduced by suckers. However, the Mauritius hemp is reproduced by bulbils. Each mother plant is capable of producing at one time as many as thousands of these young plants, bulbils. These structures appear on the central "poles" and on its many branches, as shown in Plate I, figures 1 and 2. The Mauritius plants, the subject of this report, were planted during the early part of the year 1919. About the early part of August of 1922, or about two years and one-half from the time of planting bulbils, several of the plants simultaneously produced central poles. (See Plate II.) On the branches of the poles greenish-yellow flowers were produced. Somewhere at the axils of these, young protuberances appeared, one at each axil. After further development these protuberances plainly appeared as the structures botanically known as bulbils. It requires from one to two months from the formation of the central *poles* before the bulbils become big enough to transplant to nursery beds. When mature the bulbils fall by themselves on the ground. At this stage of development the bulbils do not possess any root. A few days after the base comes in contact with the soil, the bulbils usually begin to form roots. When the young plants are about 20 centimeters in height they are ready for transplanting into permanent field.

Although the plant is largely employed for decorative purposes nevertheless it yields a certain amount of structural fiber.

This fiber is formed in the leaves. As early as the seventeeth century the power of this plant to produce fiber was known to the inhabitants of St. Helena and Mauritius. Many years ago in the latter country a fiber industry was started and the wet or retting system was tried. Dodge reports that the cut leaves were first passed through the rollers of a sugar mill and later were soaked in water for several days. The fiber was then beaten out and washed in clean water. Dodge also reports that this process proved unsuccessful as the fiber produced was discolored and weak. Then machines were invented. One of these was reported to be able to clean 1,155 pounds of fiber per day.

It has been reported that on the basis of green weight, leaves of Mauritius hemp grown in the island of the same name, yield as much as 3 per cent of fiber. It has also been reported that "the yield of fiber was at the rate of about 1½ tons per acre." This rate of yield of fiber seems good. Unfortunately this rate is not attained either in the Philippines or Ceylon. In the latter country the yield is reported by Macmillan to be 1½ to 2 per cent of fiber. The yield of fiber in the Philippines is shown in Table I.

TABLE I.—*Yield of fiber of Mauritius hemp ground under Los Baños conditions*

Plant No.	Number of leaves	Weight of leaves	Number of days to complete retting	Air dry weight of fiber	Length of fiber	Per cent of fiber
		kg.		*g.*	*cm.*	
1	74	61.5	16	1,095	162	1.78
2	62	42.0	16	590	152	1.41
3	60	54.5	10	800	143	1.47
4	58	40.6	18	650	150	1.61
5	54	34.5	21	435	151	1.28
6	88	79.4	16	900	145	1.13
7	52	39.2	25	400	132	1.02
8	67	71.0	16	468	142	0.66
9	50	38.5	20	400	134	1.04
10	51	37.5	17	307	158	0.82
11	67	73.2	21	698	180	0.96
12	....	131.6	27	1,259	143	0.95

Examining Table I will show that a mature plant of Mauritius is capable of yielding as much as over 1,000 grams of clean air dry fiber of about 160 centimeters in length. It should be noted here that contrary to experience in the Mauritius Island the fiber of this plant retted in a creek by students of the College of Agriculture at Los Baños was white, resembling very closely the fiber of the species of agave. Highly discolored and very weak fiber may of course be obtained but this case happens only when the retting process is overdone. Retting was found complete under Los Baños conditions in a two-week period.

Mauritius hemp, flowering or poling.

YIELDS OF FIBER COMPARED

The yield of fiber indicated in Table I is for individual plants of Mauritius hemp. Central poles had been produced. Consequently no more leaves could be expected to form on each plant. In round figures one can roughly assume that the yield of this plant for its entire life time is from ½ to 1 kilogram of clean air dry fiber.

The species of Agave,—*A. sisalana, A. cantala* and others,—grown side by side with Mauritius are, up to the present time, not yet producing flowers. Experience has shown that the sisal and the maguey plants grown in these Islands may live as long 10 to 12 years before central "poles" are produced. Macmillan reports that the leaves of sisal hemp, at an average, are capable of yielding 3 per cent of fiber. Stoddard[4] also reports yields of fiber of sisal hemp raised in Jamaica. From his figures and on the basis of 32 leaves harvested from each plant per year it can be calculated that a full grown plant of average-sized could yield as much as 1.5 kilos of air dry clean fiber. This amount alone is greater than what the Mauritius hemp can produce in its life time. The maguey plant also yields more fiber than Mauritius hemp. According to Saleeby[5] an average sized maguey plant may yield annually an average of 25 to 30 leaves. At the rate of 20 kilos of dry fiber to every 1,000 leaves as reported by Saleeby, a maguey plant may produce about ½ kilo of dry fiber. If this figure is multiplied by the number of years the plant is productive it will surely become evident that maguey is also very much more productive of fiber than the Mauritius hemp.

The Mauritius hemp has never been grown on a commercial scale in the Philippines. For this reason it is impossible to present very accurate figures on production. However, although not always reliable, an estimate will here be made of the yield of fiber from one hectare of Mauritius plants; the calculations to be based on the data on hand.

Assuming that the plants are to be set in the field at a distance of 3 meters each way; in one hectare there will be as many as 1,111 plants. At an average of 0.75 kilograms of air dry clean fiber per plant, the 1,111 plants in one hectare will give 833.25 kilograms of fiber, or 13.17 piculs. At ₱8 a picul,

---

[4] STODDARD, D. J. Sisal hemp. Tropical Agriculturist 42: (No. 1), 1–88. 1914.

[5] SALEEBY, M. M. Maguey (cantala) and sisal culture. Philippine Agricultural Review 6: (No. 5), 1–16. 1913.

the total gross income from one hectare would be ₱105.36. This, of course, is for a period of about four years.

MICROSCOPIC EXAMINATION

Careful microscopic examinations of the cross sections of the leaf of the Mauritius plant were made. Various sclerenchymatous strands were observed. Near either epidermis small strands composed of purely sclerenchymatous cells are found. (*See* Plate III, figs. 3, 7, and 8.) These constitute the valuable components of the Mauritius hemp in the market. However, the bulk is made up of the bundle sheaths, which are obtained as are seen under the microscope and as parts of the vascular bundles which are mostly located at the central portion of the leaf. (*See* Plate III, figs. 1, 2, 4, 5, 6 and 9.) As seen under the microscope both the sclerenchyma strands and vascular bundles in the leaf resemble very closely similar structures in the leaves of species of Agave and in the leaf sheaths of abaca, *Musa textilis* as reported by Espino.[6] In external appearance the fiber of these plants closely resemble one another. This fact suggests the need of knowing some means by which they can be distinguished from one another. Otherwise mixing or adulteration of one fiber with another could be done with comparative ease with very little chance of detection. But the chemical tests including tests on the color of the ash and the tensile strength tests soon to be reported may help solve the puzzle.

CHEMICAL EXAMINATION

Of the 25 different chemical solutions employed in color reaction tests whose results are shown in Table II, only ammonia is of real help in distinguishing the fiber of Mauritius hemp from the fiber of maguey, sisal, abaca or pineapple. With the exception of Mauritius hemp all the other fibers were colored with the reagent.

It might probably be of interest to show here how the five different fibers named above may be distinguished from one another by means of the color reaction.

After the elimination of Mauritius hemp with the use of *ammonia,* maguey may further be eliminated from the list or group with the application of *ammoniacal nickel oxide.* This solution colors all other fibers except maguey. This test eliminates this fiber. *Chlorine* water colors only the sisal. It gives pale ochraceous coloration. Abaca and pineapple fibers are not

[6] ESPINO, R. B. Abaca fiber. Philippine Agriculturist and Foresters 4: 200–216. 1916.

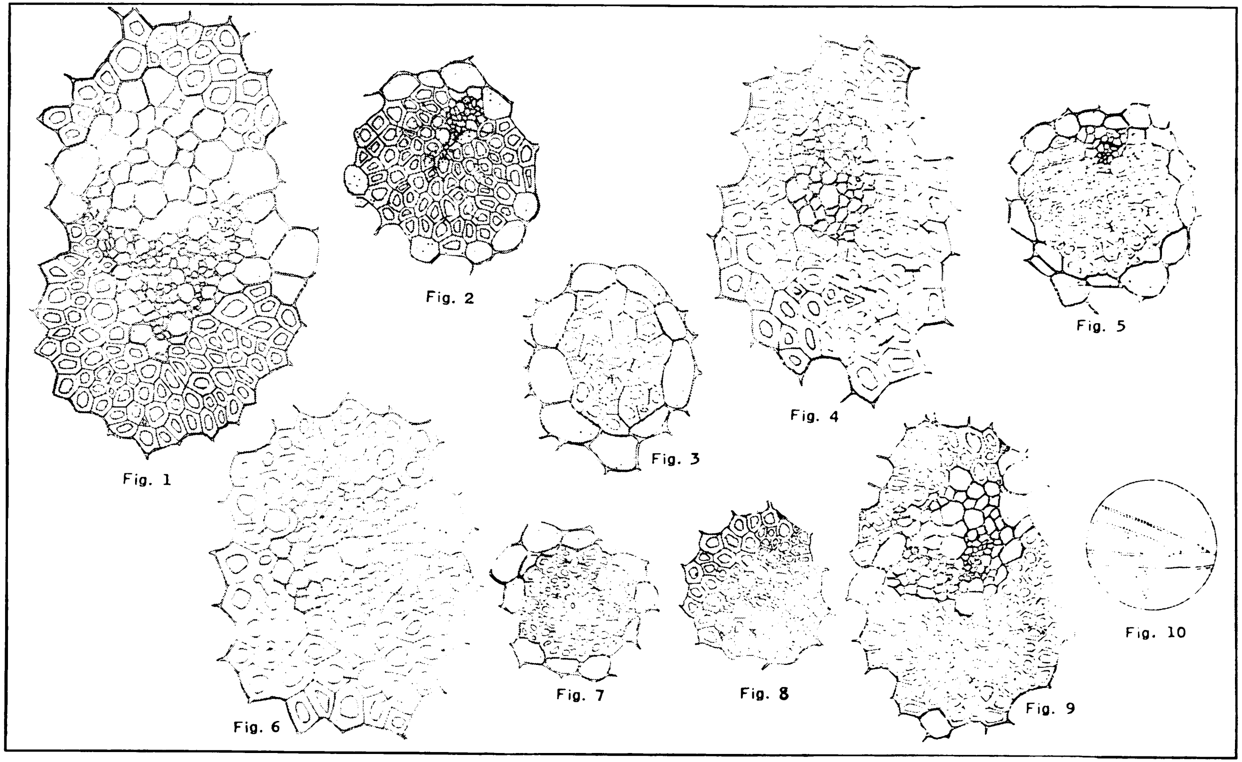


Fig. 1, 4, 6, and 9. Big vascular bundles; Figs. 2 and 5. Fiber strands with small conducting tissue; Figs. 3, 7, and 8. Purely sclereuchyma strands; and Fig. 10. Portions of fiber cells in median longitudinal view.

TABLE II.—*Reactions*[1] *of Mauritius hemp to certain chemical solutions as compared with reactions of other structural fibers to such chemical solutions*

	Solution	Mauritius hemp	Maguey	Sisal	Pineapple	Abaca
1	Acid, picric	Lemon yellow	Lemon yellow	Bright lemon yellow	Lemon chrome	Lemon yellow.
2	Acid, chromic	Maize yellow	Light sulphur yellow	Pale yellow orange	Buff yellow	Pale pinkish buff.
3	Ammonia	None	Light sulphur yellow	Pinard yellow	Light veridine yellow	Martius yellow.
4	Ammoniacal copper oxide	Light oriental green	Light cendre green	Antique green	Diamine green	Peacock green.
5	Ammoniacal nickel oxide	Light calcedony yellow	None	Viridine yellow	Light green yellow	Martius yellow.
6	Aniline sulphate	Wax yellow	Lemon chrome	Lemon yellow	Pale greenish yellow	Empire yellow.
7	Caustic potash	Cream color	Light sulphur yellow	Light picric yellow	Light greenish yellow	Baryta yellow.
8	Caustic soda	Cream color	Light sulphur yellow	Pinard yellow	Light greenish yellow	Pinard yellow.
9	Chlorine water	None	None	None	Pale ochraceous	None.
10	Cochineal tinctures	Shell pink	Pale lilac	Light orange pink	Pale flesh color	None.
11	Copper turnings	Light Terre verte	American green	Sorrento green	Ethyl green	Meadow green.
12	Cupric sulphate	None	None	Pale-viridine yellow	Pale orange yellow	Opaline green.
13	Ferric sulphate	Pinkish buff	Cartridge buff	Buff yellow	Baryta yellow	Sulphur yellow
14	Fuchsine	Cream buff	Colonial buff	Picric yellow	Picric yellow	Pale-green-yellow.
15	Iodine	Hazel	Hazel	Deep ochraceous yellow	Sudan brown	Hazel.
16	Lead acetate	None	None	None	None	None.
17	Mercuric nitrate	None	None	None	None	None.
18	Phloroglucine	Primuline yellow	Apricot yellow	Light cadmium	Apricot yellow	Primuline yellow.
19	Potassium chromate	Barium yellow	Light sulphur yellow	Pale lemon yellow	Light green yellow	None.
20	Silver nitrate	None	None	None	None	None.
21	Sodium chloride	None	None	None	None	None.
22	Sodium plumbate	Naphthaline yellow	Sulphur yellow	Sulphur yellow	Pale greenish yellow	Naphthaline yellow.
23	Sodium copper oxide	Deep glaucous green	Pale-cendre green	Pale-viridine yellow	Neva green	Opaline green.
24	Stanic chloride	None	None	None	None	None.
25	Zinc chloride	None	None	None	None	None.

[1] Ridgway, Robert. Color standards and color nomenclature. Washington, D. C., 1912.

stained. Fiber of abaca may be distinguished from that of pineapple in that the latter is usually of a finer texture than the abaca. Moreover, cochineal tincture and potassium chromate gives the fiber a light green-yellow coloration.

The color of ash may also be of help in distinguishing the fibers from one another. In the ash color tests that for the pineapple fiber was not ascertained. The ash from the fiber of abaca is decidedly and conspicuously different from the rest. Its color was *slate black mixed with white and gray.* The ash of Mauritius hemp and of sisal were exactly the same, being *pale vinaceousfawn.* That of maguey closely resembled this color but was exactly tilleulbuff according to Ridway's manual of colors.

As shown in Table III the per cent of ash of Mauritius hemp, in term of the air dry fiber, was about the same as that for the other fibers. However, in the present test only 1.19 per cent was obtained for the Mauritius. Previous researches on the subject show that 2.1 per cent ash was obtained in India. The discrepancy was likely due to difference of the moisture contents of the samples employed; for the data from India seem to be based on the dry weight of the sample, as shown in Table IV.

Further examination of Tables III and IV may show data of value for more technical studies of the subject. It will, however, suffice to note here that the actual amount of ash obtained from samples of fiber composed of 20 filaments 70 centimeters in length each was smallest in the case of the Mauritius hemp. The largest amount was obtained from the abaca. The difference between the two was a little over 100 per cent. Maguey and Sisal also had larger amount of ash than the Mauritius hemp. Further reference to these data will be made in connection with the study of the comparative strength of the four different kinds of fiber. If the results from India could be compared with those from Richmond's, the Mauritius hemp had the lowest amount of cellulose, being 70 per cent; while sisal had 77.6 per cent, 73.68 per cent for the abaca fiber and 77 per cent for maguey. As will be seen later the relatively low percentage of cellulose and consequently the relatively low amount of ash that the Mauritius hemp contains may explain why this fiber is comparatively weaker than any of the other three kinds here studied. However, this generalization is made only tentatively.

TABLE III.—*The ash contents of some structural fibers*

Sample No.	Mauritius hemp			Sisal			Maguey			Abaca		
	Sample of fiber	Ash		Sample of fiber	Ash		Sample of fiber	Ash		Sample of fiber	Ash	
		Weight	Per cent		Weight	Per cent		Weight	Per cent		Weight	Per cent
	g.	g.		g.	g.		g.	g.		g.	g.	
1	3.218	0.0037	1.15	7.824	0.0082	1.05	6.862	0.0055	0.81	6.300	0.0111	1.76
2	3.656			9.397	0.0067	0.71	6.030	0.0081	1.31	5.926	0.0084	1.41
3	2.365	0.0020	0.84	8.705	0.0011	1.26	4.731	0.0066	1.51	6.645	0.0018	0.31
4	2.414	0.0030	1.24	7.805	0.0010	0.13	4.781	0.0057	1.21	6.813	0.0011	0.19
5	2.333	0.0036	1.54	7.733	0.0035	0.45	4.666	0.0045	0.97	5.133	0.0081	1.22
6				8.893	0.0085	0.95	5.036	0.0038	0.75	5.516	0.0071	1.04
7							4.216	0.0063	1.26	5.816	0.0055	0.95
8										5.314	0.0080	1.52
9										5.214	0.0080	1.53
10										4.844	0.0055	1.13
Average	2.797	0.0031	1.19	8.393	0.0048	0.76	5.175	0.0058	1.12	5.853	0.0065	1.11
Color of ash	Pale vinaceous-Fawn			Pale vinaceous-Fawn			Tilleul-Bulf			Slate-black mixed with white and gray.		

TABLE IV.—*Results of chemical tests of Mauritius hemp, sisal, abaca, and maguey*

	Mauritius hemp.[a]	Sisal hemp.[a]	Abaca hemp.[b]	Maguey.[b]
Moisture	9.3	9.3	8.10	9.23
Ash	2.1	1.2	1.08	1.96
Hydrolysis, loss[a]	17.1	11.4	13.83	13.78
Hydrolysis, loss[b]	23.9	16.0	20.79	15.70
Acid purification, loss	6.1	2.1	....	....
Mercerisation, loss	12.0	8.4	....	....
Nitration, gain	28.0	41.2	....	....
Cellulose	70.0	77.6	73.68	77.00

[a] From Bangalore, India.
[b] RICHMOND, G. F. Philippine fibers and fibrous substances: There suitability for paper making. Philippine Journal of Science. 1: (No. 6) 433-462. 1906.

Other chemical characteristics of the Mauritius plant—not of the fiber—may be mentioned here. Quoting Dodge:

"The pulp of the leaves when crushed gives off strong pungent odor, and hence this species is sometime called the foetid aloe. The juice is strongly corrosive and soon acts upon wrought iron; it is said to produce less effect on cast iron, while it is practically inoperative on brass and copper."

Mr. N. D. Tiedeman working in Los Baños for the International Health Board of the Rockefeller Foundation has secured leaves of Mauritius hemp and certain species of Agave from the College of Agriculture for his studies on larvacides. Mr. Tiedeman was kind enough to have furnished us some of his results. The following is quoted from his reports:

"In our search for a cheap larvacide for use in mosquito control, we were led to try Agave leaves after hearing of their effect on fish. They would of course only be useful in places where there were no fish such as small shallow pools. We found that the solution formed by soaking the fresh leaves of Agave cantala in water for 24 hours would kill anopheles mosquito larvae. This led us to run a series of tests using solutions of known concentration. In these tests *Agave fourcroydes, Agave sisalana, Agave zapupe,* and *Furcroea gigantea* were used. Three hundred grams of the fresh leaves of each were placed each in two liters of water. Small portions of each were drawn off each day for 14 days and 5 anopheles and 5 culex larvae placed in each and the times of death noted. We found that after standing 24 hours and up to about the 10th day, these solutions killed anopheles larvae in 30 minutes or less as a rule and culex larvae within 6 hours. *Furcroea gigantea* gave the poorest results, losing its strength after 7 days and requiring a longer time to kill the larvae. The relative effectiveness of *Agave fourcroydes, Agave sisalana,* and *Agave zapupe* de-

creased in the order named. The above solutions, however, when diluted to 10 per cent of their original strength were not effective but larvae placed in them went through the normal process of development. We concluded that they were not of of economic importance."

TENSILE STRENGTH

Results of comparative study of the tensile strength of individual fiber of certain species of agave and *Furcroea gigantea* are given in the Bulletin of the Imperial Institute.[8] In this study are included fibers of species of agave that do not exist in these Islands. However, the data obtained on sisal hemp

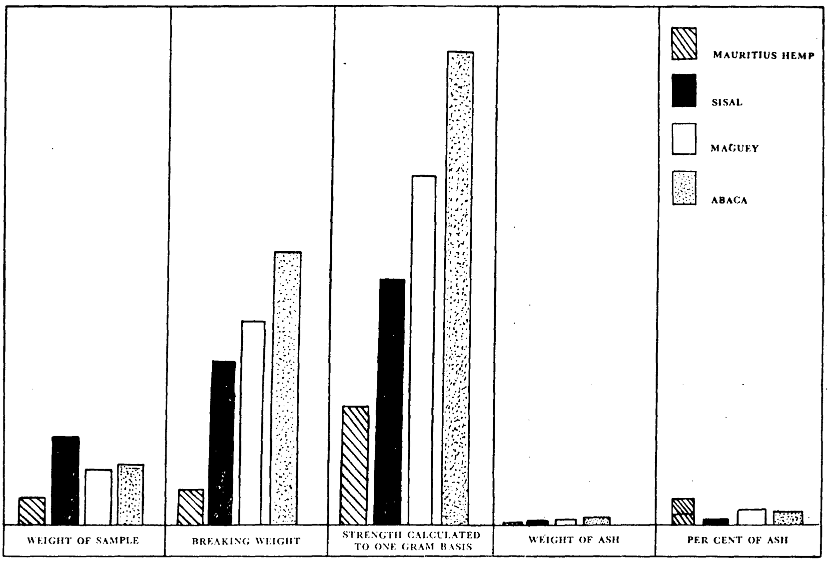


Fig. 3 Graphical comparison of tensile strength and ash contents

and on the Mauritius hemp might be of interest to us. On the basis of 100 for the strongest fiber it was found that No. 4 and 3 Sisal hemp gave relative strength of 100 and 87.5, respectively; while the strength of the fiber of the Mauritius was rated only 81.

The order of the relative strength of these two kinds of fiber seems to have been confirmed by the results of tensile strength tests made at the College as shown in Table V.

Examination of Table V will show that the fiber of Mauritius was weaker than any of sisal, maguey, or abaca. This is true

---

[8] Annonymous, Agave and Furcroea fibers from Madras, Bulletin of the Imperial Institute 4: 1–394. 1906.

TABLE V.—*Tensile strength of several structural fibers*[a] *compared with that of Mauritius hemp*

Trial No.	Mauritius hemp			Sisal			Maguey			Abaca		
	Breaking weight	Weight of sample	Strength calculated to gram basis	Breaking weight	Weight of sample	Strength calculated to gram basis	Breaking weight	Weight of sample	Strength calculated to gram basis	Breaking weight	Weight of sample	Strength calculated to gram basis
	kg.	*gr.*	*kg.*	*kg.*	*gr.*	*kg.*	*kg.*	*gr.*	*kg.*	*kg.*	*gr.*	*kg.*
1	4.32	3.218	13.42	20.00	7.824	25.56	22.95	6.862	34.71	29.79	6.300	47.28
2	3.32	3.656	9.08	19.72	9.397	20.98	19.58	6.030	32.47	29.32	5.926	49.48
3	2.95	2.365	12.47	19.67	8.705	22.34	17.27	4.731	36.50	29.32	5.645	45.77
4	2.73	2.414	11.31	19.45	7.805	24.92	15.68	4.781	32.79	27.27	6.813	40.02
5	2.50	2.333	10.71	19.18	7.733	24.80	15.41	4.666	33.03	27.04	5.133	52.68
6	....	....	....	17.95	8.893	20.18	15.41	5.036	30.59	25.91	5.516	46.99
7	....	....	....	....	....	....	13.64	4.216	32.35	24.19	5.816	41.42
8	....	....	....	....	....	....	....	....	....	23.41	5.314	44.05
9	....	....	....	....	....	....	....	....	....	22.73	5.214	43.59
10	....	....	....	....	....	....	....	....	....	22.73	4.844	46.92
Average	3.16	2.797	11.39	15.98	8.393	23.63	19.97	5.175	33.74	26.16	5.853	45.82

[a] 20 fibers in each sample of 70 cm. in length each sample.

both in term of the *actual breaking weight* and in term of the strength *calculated* to one-gram basis. As is to be expected abaca was the strongest—from 4 to 8 times stronger than the Mauritius hemp. Sisal or Maguey was from 3 to 5 times stronger than the Mauritius hemp. This is true in term of the two criteria on strength indicated in the table.

As already referred to in one of the preceding paragraphs the tensile strength of the fiber is somewhat correlated with the ash content of the sample, at least with the actual weight of the ash. Such direct correlation does not exist when the ash is expressed in term of percentage based on the air-dry weight of the sample of fiber. Figure 2 illustrates such a correlation. This figure plainly shows the superiority in tensile strength of abaca over any of the other three kinds of fiber tested. Conversely, it is also shown that the Mauritius hemp was decidedly the weakest of all the kinds of fiber tested.

ECONOMIC IMPORTANCE

Although other countries have long ago recognized the value of the fiber of the Mauritius hemp for various purposes nevertheless the plant when grown in the Philippines is primarily not for its fiber but for its value as a substitute for fences and for ornamental purposes.

As early as 1876 it was reported in Venezuela that the fiber of Mauritius hemp was used for making ropes and in the manufacture of gunny bags. Dodge reports that the fiber is also utilized in the manufacture of horse blankets, fish nets, halters, and hammocks. Matthews said that the fiber is more largely employed for mixing with Manila (abaca) and sisal in making medium grades of cordage. The same writer further said, "when the better grades of cordage fiber (Manila and sisal) are abundant and quoted low in the market, Mauritius is likely to fall below the cost of production."

The fact that Mauritius hemp fiber is comparatively weak and the plant is relatively short-lived and light yielder of fiber; and inasmuch as in the Philippines there exist several plants capable of producing fiber of proved commercial value, namely, abaca, maguey, sisal, pineapple, etc., it therefore appears that there is a very little chance or none at all, for the Mauritius hemp to be grown on extensive field scale in these Islands. Indeed we should not extensively grow this plant as its fiber might be seriously employed as an adulterant of our famous and valuable abaca, thereby damaging the good reputation of the latter.

THE FIBER ELEMENTS OF SOME FIBER-AGAVES AND MAURITIUS HEMP

By VICENTE C. ALDABA
Of the College of Agriculture

INTRODUCTION

The genus *Agave* includes a very large number of species, more than 325 having been described.[1] Most of the species are valuable only as ornamental plants, but some are very important economically. The *A. fourcroydes, A. sisalana,* and *A. contala* furnish about 90 per cent of all the fibers that go into the manufacture of binder twine the annual consumption of which amounts to 150,000 tons.[2] The alcoholic drinks, "pulque" and "mescal," are made by the Mexicans from the sap of some of the species. Other species are used as fodder for stock; and at least one, *A. saponaria,* is used as substitute for soap.

The fibers obtained from the different fiber-producing species differ in qualities, hence have not the same market values. The study of their fiber elements may not only explain the difference in qualities but also furnish a means of identification.

AGAVE CANTALA

Agave cantala is cultivated commercially in the Philippines, Java, and India. The fiber produced in the Philippines is known in commerce as "Manila Maguey," "Manila Aloe," and "Philippine Maguey;" that from Java as "Java Sisal," "cantala", etc.; and that from India as "India Sisal," and "Bombay Aloe."[2]

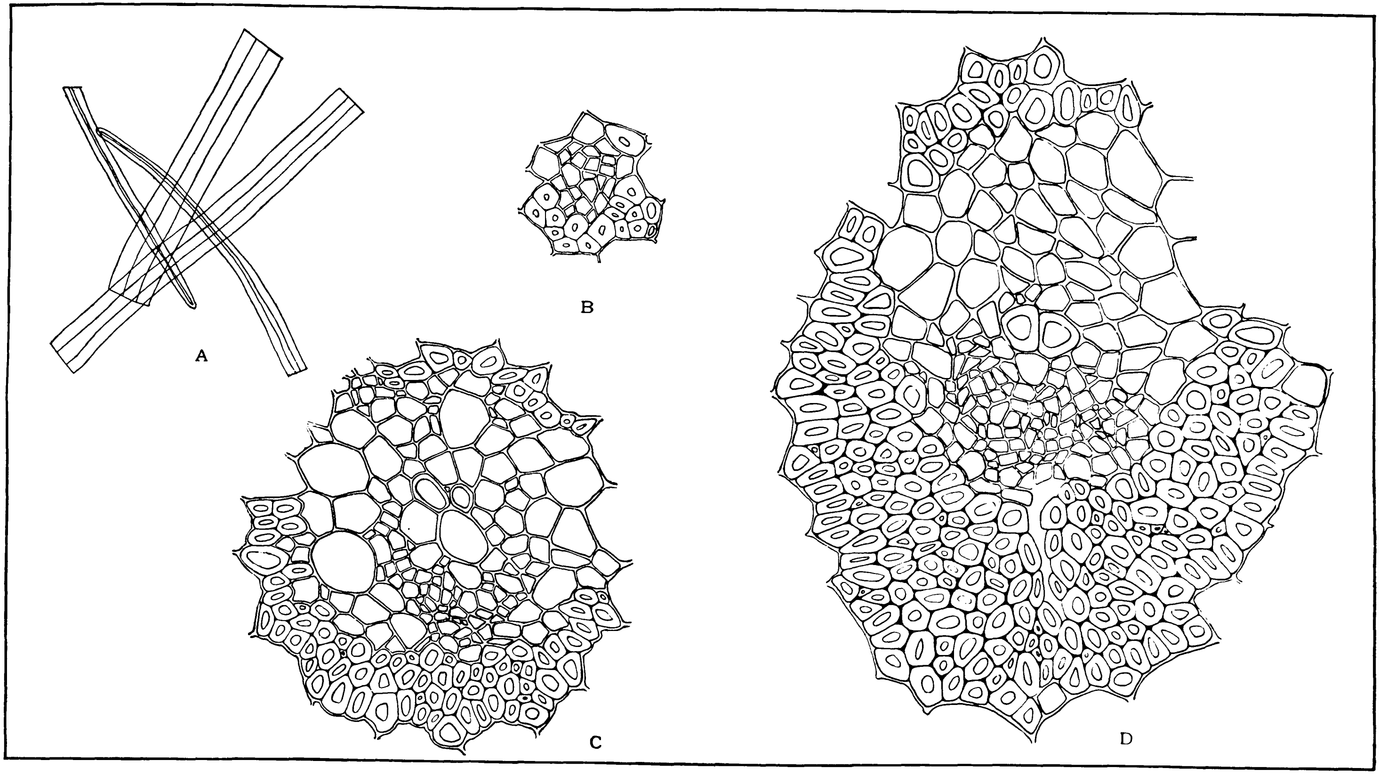
In the Philippines where it was introduced from Mexico, it is the most widely distributed species of *Agave,* being known and utilized in practically all the provinces. It is known, locally, as maguey, a name applied also to the fiber. The export of maguey from the Philippines in 1901 was 875 tons. This figure rose to 1875 tons in 1905, an increase of 115 per cent in four years. In 1916 and 1917, due to the high prices obtaining during the war, the exports were respectively 15,639,716 kilograms valued at ₱3,479,978 and 14,693,418 kilograms valued at ₱4,696,716.

---

[1] ANONYMOUS. Standard Cyclopedia of Horticulture, Vol. I, 230–240.

[2] SALEEBY M. M. Maguey (cantala) and sisal in the Philippines. Philippine Agricultural Review, 6: 183–188. 1913.

PLATE IV



"Agave cantala" (Maguey). A single fiber elements; B, cross section of smallest fiber strand; C and D, cross sections of large fiber strands.

Preparation of fiber.—Practically all the maguey fiber produced in the Philippines is prepared by retting, largely in salt water. It has been reported that manufacturers object to salt-water-retted fiber because binder twine made from it is destroyed while in storage by crickets trying to get the salt. To maintain a market or demand it is necessary, then, that maguey fiber be prepared by retting in fresh water or by means of machinery.

Quality of fiber.—Retted maguey is weak and discolored. Even when properly cleaned it is not as well adapted for binder twine as either the sisal or henequen, which are finer and softer.[3] It is said, also, that the yield of fiber in maguey is less than that of sisal or henequen. For these reasons an attempt is being made in the Philippines to replace maguey with sisal.

AGAVE SISALANA

The A. sisalana produces the true sisal of commerce. The commercial name of the fiber varies according to the country in which it is produced, as for example, "Hawaiian Sisal," "Bahama Sisal," and "East African Sisal."[2] Because of the adaptability of this species to wider range of climatic and soil conditions than the other fiber agaves it is now the most widely distributed.

This Agave was introduced from Hawaii into the Philippines in 1904.[3] In 1916 and 1917 for the first time sisal appeared as a separate item in the Philippine exports. The figures for 1916 were 45,922 kilograms valued at ₱13,164; and for 1917, 100,437 kilograms valued at ₱34,648.

Preparation and quality of fiber.—Sisal is prepared in the Philippines in the same way as maguey. In commercial plantations in Hawaii, Bahama, and East Africa machines are used in preparing the fiber. Good machine-cleaned fiber is ivory white with a good luster.[4] It is stronger than henequen and commands a better price as it can be used to advantage in making higher grades of cordage than binder twine. But when it is cleaned by hand after the leaves are soaked in water to soften the pulp it is too poor even for binder twine, except for mixing in the lowest grades.

---

[2] SALEEBY M. M. Maguey (cantala) and sisal in the Philippines. Philippine Agricultural Review, 6: 183–188. 1913.

[3] EDWARD, H. T. Sisal and Henequen as Binder twine Fibers, Yearbook of the Department of Agriculture, U. S. A., 357–366. 1918.

[4] DEWEY, L. H. Fibers used for binder twine, Yearbook of the Department of Agriculture, U. S. A., 193–200. 1911.

AGAVE FOURCROYDES

This species is known also as Henequen, a name applied to the fiber obtained from it. In commerce the fiber is also known as "sisal," "Mexican Sisal," and "Yucatan Sisal."[2] It is the most important binder twine fiber. Its culture is limited practically to Mexico which supplies 80 per cent of all the fiber that is manufactured into binder twine. Practically all the henequen of commerce is cleaned by machinery within 48 hours after cutting. It is light reddish yellow in color and from 90 to 120 centimeters long.[4]

AGAVE ZAPUPE

Zapupe is cultivated in eastern Mexico. The fiber, which is cleaned by the same machine employed in cleaning the henequen or sisal, is softer and finer than henequen.[4]

FOURCROEA GIGANTEA

This species belongs to the same family as the agaves. It is not thoroughly naturalized in Hawaii where the plant is known as "Malina Sisal." The fiber is known commercially as "pita." It is long and fine, but inferior to sisal in strength.[5] *Fourcroëa gigantea* is extensively cultivated in Mauritius. The fiber is commercially known as "Mauritius Hemp."

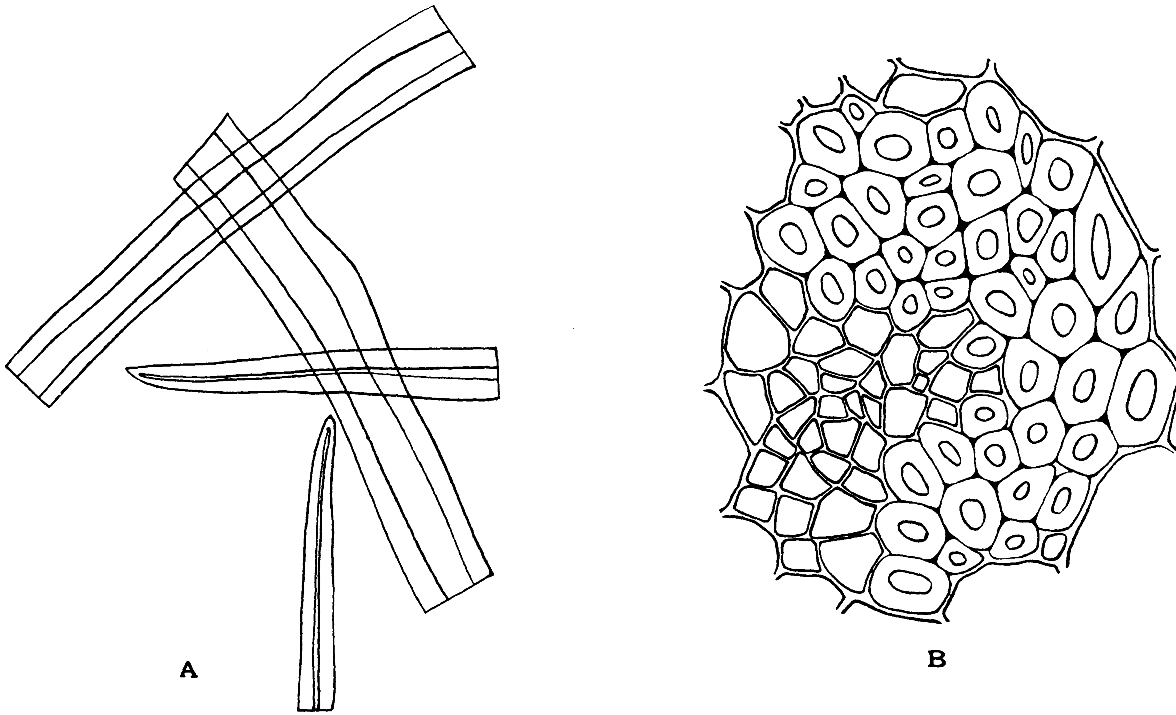
MICROSCOPIC STUDY

The materials for this study were obtained by the worker from plants growing at the College of Agriculture. In all species studied, the fiber strands of the leaf may roughly be classified into two groups: (*a*) the small-sized-fiber strands found in the two rows next to the epidermal tissues of the leaf, and (*b*) the larger-sized-fiber strands found between these two rows. Ten fiber elements were measured from each group. The leaves from which the fiber specimens were obtained were mature. An eye piece Spencer micrometer was used. Cross sections of the fibers and individual fiber elements to show the distinguishing characteristics were drawn with the aid of a camera lucida. Table I gives the measurements:

---

[4] DEWEY, L. H. Fibers used for binder twine, Yearbook of the Department of Agriculture, U. S. A., 193–200. 1911.

[5] MCCAUGHEY, V. and WEINRICH, W. Sisal in the Hawaiian Islands. Tropical Agriculturist, Vol. I, No. 2, 1–6. 1918.



A

B

"Agave sisalana" (Sisal). A single fiber elements; B. cross section of smallest fiber strand.

TABLE I.—*Dimensiones*

[All measurements

Scientific name.	Size of fiber strand.		1	2
Agave cantala	Large fiber strand	Gross diameter	0.0148	0.0167
		Diameter of lumen	0.0046	0.0016
		Thickness of wall	0.0049	0.0079
		Length of cell	1.8261	1.6565
	Small fiber strand	Gross diameter	0.0165	0.0151
		Diameter of lumen	0.0034	0.0011
		Thickness of wall	0.0061	0.0063
		Length of cell	2.0892	2.2449
Agave sisalana	Large fiber strand	Gross diameter	0.0154	0.0175
		Diameter of lumen	0.0063	0.0107
		Thickness of wall	0.0063	0.0045
		Length of cell	4.6932	3.2076
	Small fiber strand	Gross diameter	0.0187	0.0178
		Diameter of lumen	0.0063	0.0076
		Thickness of wall	0.0057	0.0060
		Length of cell	2.5920	2.5899
Agave fourcroydes	Large fiber strand	Gross diameter	0.0184	0.0212
		Diameter of lumen	0.0078	0.0086
		Thickness of wall	0.0050	0.0066
		Length of cell	2.8078	4.0352
	Small fiber strand	Gross diameter	0.0218	0.0147
		Diameter of lumen	0.0096	0.0077
		Thickness of wall	0.0053	0.0042
		Length of cell	1.5799	1.8941
Agave zapupe	Large fiber strand	Gross diameter	0.0159	0.0164
		Diameter of lumen	0.0004	0.0033
		Thickness of wall	0.0082	0.0070
		Length of cell	1.4593	2.4067
	Small fiber strand	Gross diameter	0.0149	0.0155
		Diameter of lumen	0.0037	0.0051
		Thickness of wall	0.0054	0.0053
		Length of cell	1.7199	1.9056
Fourcrœa gigantea	Large fiber strand	Gross diameter	0.0358	0.0440
		Diameter of lumen	0.0257	0.0316
		Thickness of wall	0.0058	0.0053
		Length of cell	3.6066	4.2016
	Small fiber strand	Gross diameter	0.0302	0.0237
		Diameter of lumen	0.0191	0.0155
		Thickness of wall	0.0052	0.0036
		Length of cell	2.9844	2.5476

of the fiber cells

in millimeters]

3	4	5	6	7	8	9	10	Average.
0.0178	0.0160	0.0158	0.0147	0.0248	0.0252	0.0177	0.0148	0.0178
0.0032	0.0012	0.0054	0.0026	0.0152	0.0084	0.0030	0.0048	0.0050
0.0073	0.0080	0.0068	0.0060	0.0039	0.0072	0.0079	0.0054	0.0065
3.5794	2.8967	2.6715	3.4674	5.6798	3.3764	3.0058	1.9970	3.0157
0.0116	0.0149	0.0151	0.0104	0.0130	0.0131	0.0139	0.0124	0.0136
0.0037	0.0042	0.0029	0.0025	0.0041	0.0038	0.0027	0.0032	0.0032
0.0047	0.0053	0.0059	0.0043	0.0056	0.0048	0.0053	0.0045	0.0053
1.7648	3.8100	2.7176	2.0715	3.7882	2.9033	1.7533	1.2909	2.4434
0.0178	0.0205	0.0188	0.0175	0.0169	0.0199	0.0134	0.0132	0.0171
0.0117	0.0115	0.0101	0.0123	0.0089	0.0084	0.0067	0.0079	0.0095
0.0068	0.0066	0.0041	0.0036	0.0049	0.0072	0.0030	0.0045	0.0052
1.6417	2.1197	2.0382	1.2484	3.5139	3.2928	2.9568	2.2636	2.6977
0.0135	0.0191	0.0128	0.0173	0.0164	0.0158	0.0147	0.0191	0.0165
0.0048	0.0053	0.0049	0.0089	0.0045	0.0050	0.0056	0.0105	0.0063
0.0049	0.0082	0.0047	0.0048	0.0064	0.0057	0.0054	0.0046	0.0056
2.2819	2.6493	2.9585	2.8856	2.7518	2.8131	2.2853	1.9431	2.5751
0.0141	0.0124	0.0145	0.0191	0.0163	0.0177	0.0215	0.0191	0.0176
0.0055	0.0124	0.0069	0.0096	0.0069	0.0079	0.0112	0.0076	0.0084
0.0040	0.0053	0.0034	0.0046	0.0058	0.0053	0.0048	0.0059	0.0051
2.4528	2.5941	2.0028	2.9173	1.2443	2.6855	2.5661	3.2072	2.6513
0.0191	0.0140	0.0185	0.0232	0.0160	0.0163	0.0178	0.0179	0.0179
0.0067	0.0052	0.0075	0.0119	0.0065	0.0074	0.0067	0.0051	0.0074
0.0063	0.0044	0.0060	0.0061	0.0049	0.0049	0.0053	0.0067	0.0054
2.0690	1.3217	2.6188	2.0337	1.4522	1.9764	1.8941	2.1823	1.9022
0.0179	0.0163	0.0180	0.0148	0.0222	0.0124	0.0106	0.0140	0.0158
0.0054	0.0037	0.0026	0.0027	0.0059	0.0019	0.0012	0.0045	0.0032
0.0063	0.0058	0.0057	0.0060	0.0081	0.0063	0.0051	0.0044	0.0063
2.5117	1.8117	2.1642	2.3882	3.7181	3.8195	1.4823	3.2657	2.5028
0.0154	0.0135	0.0137	0.0155	0.0147	0.0159	0.0159	0.0161	0.0151
0.0044	0.0027	0.0029	0.0030	0.0045	0.0035	0.0055	0.0047	0.0040
0.0052	0.0058	0.0064	0.0067	0.0052	0.0063	0.0055	0.0058	0.0058
1.4856	1.6689	1.7924	2.5072	1.9950	2.2910	1.6396	1.7500	1.8655
0.0050	0.0433	0.0538	0.0359	0.0344	0.0449	0.0344	0.0492	0.0411
0.0226	0.0340	0.0419	0.0262	0.0231	0.0303	0.0223	0.0400	0.0297
0.0065	0.0050	0.0047	0.0050	0.0056	0.0066	0.0057	0.0054	0.0056
3.0820	2.6768	2.6077	2.4376	3.5329	4.2716	2.9050	2.8580	3.2180
0.0243	0.0250	0.0296	0.0306	0.0268	0.0180	0.0166	0.0226	0.0247
0.0152	0.0144	0.0201	0.0191	0.0167	0.0096	0.0096	0.0120	0.0151
0.0049	0.0058	0.0051	0.0060	0.0047	0.0033	0.0033	0.0052	0.0047
1.4173	2.7172	2.7695	3.5354	4.3437	2.1494	3.3637	2.9511	2.8779

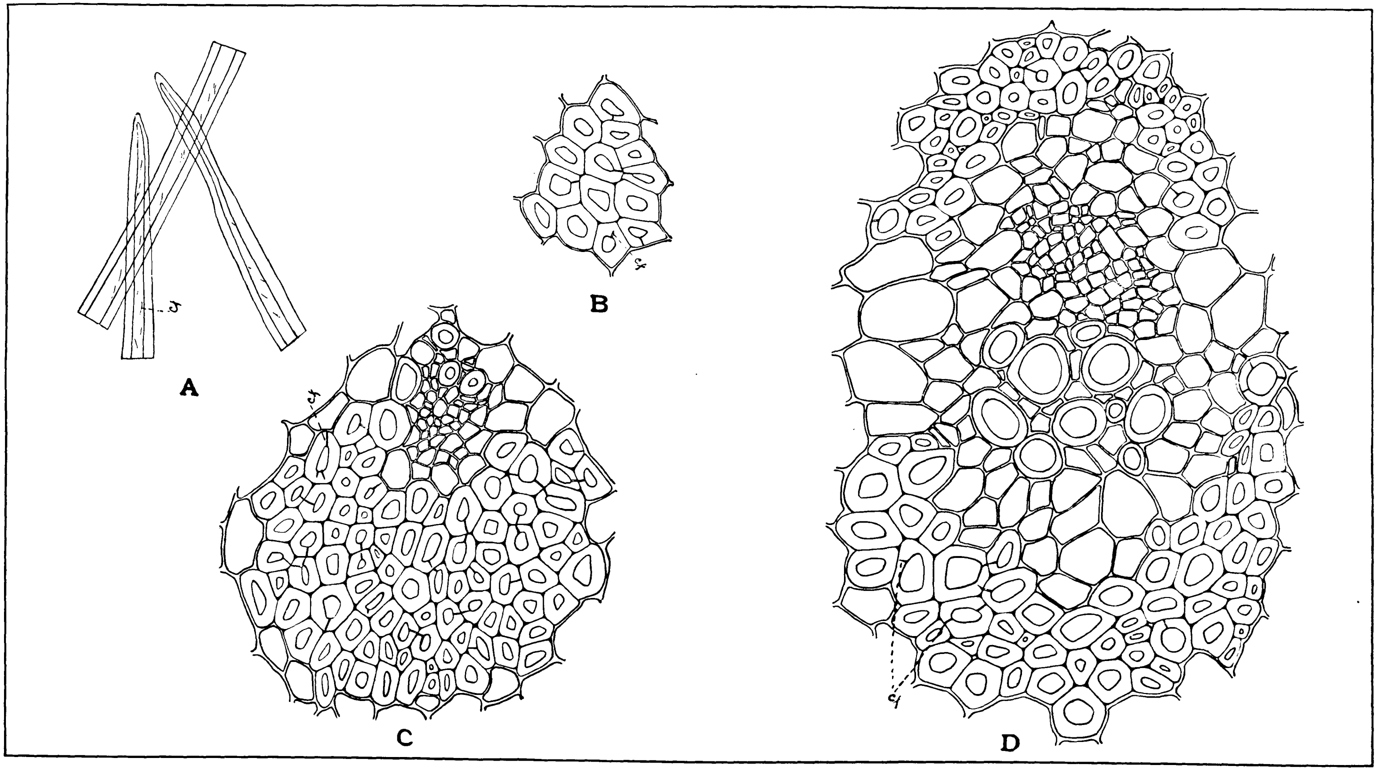
TABLE II.—*Minimum, maximum, and average dimensions of the fiber cells* [a]

Scientific name		Gross diameter			Diameter of lumen		
		Minimum	Maximum	Average	Minimum	Maximum	Average
A. cantala	Large fiber strand	0.0147	0.0252	0.0178	0.0012	0.0084	0.0050
	Small fiber strand	0.0104	0.0165	0.0136	0.0011	0.0042	0.0032
A. sisalana	Large fiber strand	0.0132	0.0205	0.0171	0.0063	0.0123	0.0095
	Small fiber strand	0.0128	0.0191	0.0165	0.0045	0.0105	0.0063
A. fourcroydes	Large fiber strand	0.0124	0.0215	0.0174	0.0055	0.0124	0.0085
	Small fi' er strand	0.0140	0.0218	0.0179	0.0067	0.0119	0.0074
A. zapupe	Large fiber strand	0.0106	0.0222	0.0158	0.0004	0.0059	0.0032
	Small fiber strand	0.0136	0.0161	0.0151	0.0027	0.0055	0.0040
F. gigantea	Large fiber strand	0.0344	0.0538	0.0411	0.0223	0.0419	0.0297
	Small fiber strand	0.0166	0.0306	0.0247	0.0096	0.0201	0.0151

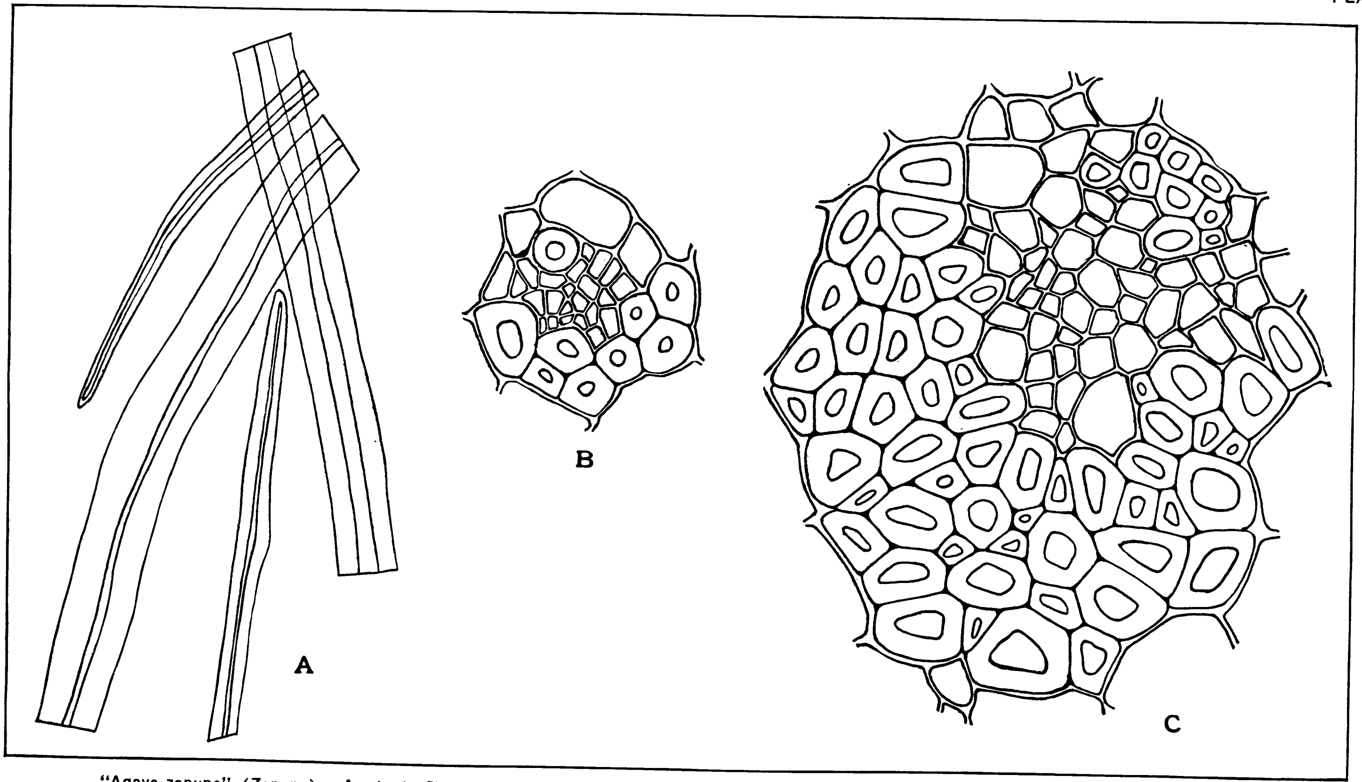
Scientific name		Thickness of wall			Length of cells		
		Minimum	Maximum	Average	Minimum	Maximum	Average
A. cantala	Large fiber strand	0.0049	0.0080	0.0065	1.6565	5.6798	3.0157
	Small fiber strand	0.0043	0.0063	0.0053	1.2909	3.8100	2.4434
A. sisalana	Large fiber strand	0.0030	0.0072	0.0052	1.2484	4.6932	2.6977
	Small fiber strand	0.0046	0.0082	0.0056	1.9431	2.9585	2.5751
A. fourcoydes	Large fiber strand	0.0034	0.0066	0.0051	1.2443	4.0352	2.6513
	Small fiber strand	0.0042	0.0067	0.0054	1.3217	2.1823	1.9022
A. zapupe	Large fiber strand	0.0044	0.0082	0.0063	1.4593	3.8195	2.5027
	Small fiber strand	0.0052	0.0067	0.0057	1.4856	2.5072	1.8655
F. gigantea	Large fiber strand	0.0047	0.0066	0.0055	2.4376	4.2716	3.2179
	Small fiber stradd	0.0033	0.0060	0.0047	1.4173	4.3437	2.8779

[a] Table II was constructed to aid in working clearer the data given in Table I.

It may be seen from Tables I and II that, generally speaking, the dimensions of the fiber cells from the large fiber strands are greater than those of the cells from the small strands. Considering the averages, the only exceptions are: (1) the gross diameter of the cells from the large strand of henequen is about equal to that of the small strand; (2) the diameter of the lumen of the cells from the small strand of zapupe, is slightly greater than that of the cells from the large strand; and (3) the averages of the thickness of the walls of the cells from both kinds of strands of sisal are about equal. The cells of zapupe are less in gross diameter and length than the cells of the other fibers considered including the Mauritius hemp, except the gross diameter of the cells from the small strands of maguey, which is smaller than that of zapupe. Considering the averages of all the cells from both sizes of strands from each species, the diameter of the lumen of zapupe is the smallest, of the Mauritius hemp the largest, and of the sisal and the henequen about equal. There is not very much difference in the thickness of the walls of the different fiber cells. The longest cell is found in maguey, the maximum length being 5.6798 millimeters. Cells of Mauritius hemp have extraordinarily large gross diameter and lumen. In fact these characteristics are so pronounced as



"Agave furcroydes" (Henequen). A, single fiber element; B, cross section of smallest fiber strand; C and D, cross section of large fiber strands.



"Agave zapupe" (Zapupe). A, single fiber elements; B, cross section of smallest fiber strand; C, cross section of large fiber strand.

to distinguish this fiber from the others. The thickness of the walls of the cells of maguey and zapupe is greater than the lumen with the exception of two cells from the large strands of maguey and one cell from each kind of strands of zapupe. In the other fibers the diameter of the lumen is greater than the thickness of the wall. In the case of sisal the difference is not so great in the cells from the small strands and there is quite a number of cells in which the reverse is true. But on the whole considering the cells from the strands of both sizes, the diameter of the lumen is greater than the thickness of the wall. In the cells of henequen and Mauritius hemp the difference is so great as to be readily seen. The cross section of small fiber strands of the sisal shows larger number of cells than the small strands of the agave fiber considered.

Descriptions of the cells.—The cross section of the fiber cells are polygonal with corners somewhat rounded. The size of the polygons as shown in the illustrations vary owing to the varying size of the cells and to the fact that the cells which are tapering in shape were cut at different parts in preparing the section. The lumen has a tendency to polygonal shape also but is more rounded than the outer outline of the cell. The thicker the wall the more rounded the lumen. The lumen does not show any contraction and extends to the end of the cell.

Crack-like fissures are conspicuous in the cross section of the fiber cells of henequen and Mauritius hemp. These fissures are seen as lines slanting to the longitudinal section of the individual fiber cells. Zapupe, maguey, and sisal have no fiber strands without conducting tissue, while in the other species there are strands without it. The individual cells from different fibers have, aside from the relation between the thickness of the wall and the diameter of the lumen, characteristics which are readily distinguished. The fiber cells of zapupe are very tapering with almost sharp ends and can be distinguished from those of the maguey which are not so tapering and more frequently have rounded ends. The crack-like fissures in the cells of the henequen distinguishes it from the other fibers. The cells of Mauritius hemp also show these fissures but the fiber cannot be confused with the other fibers because of its extraordinarily large size with very large lumen. The cells of sisal have sharper ends than those of the maguey, and it can also be distinguished by the lumen which is wider than the thickness of the wall.

KEY TO THE IDENTIFICATION OF THE FIBER AGAVES AND MAURITIUS HEMP

NOMENCLATURE

The nomenclature of the fiber *agaves* is much confused and a species is frequently designated by different names. For this reason, the synonyms and other names which are confused with the agaves discussed in this paper are now included. The following key was devised by Dewey.[6]

1. *Agave fourcroydes*, Lemaier.
   Henequen (Spanish name).
   Sacci (Maya Indian name).
   Wisse Sisal (German).

Synonyms: *Agave rigida elongata.*
Agave elongata.
Agave ixtle.
Agave rigida longifolia.

2. *Agave sisalana*, Perrine.
   Sisal, Originally Spanish port of shipment.
   Yacci, Maya Indian name.
   Grun Sisal, German.
   Henequen, Verde Spanish.

Synonyms: *Agave rigida sisalana.*

3. *Agave cantala*, Roxburgh.
   Nanas sabrang (Java).
   Manila maguey (Philippine).

Synonyms: *Agave cantula.*
Agave vivipara. }
Agave rigida elongata. } in Java.
Agave elongata }

4. *Agave zapupe*, Trelease.
   Zapupe azul.
   Zapupe de Estopier.

NOTE.—(*u* a typographical error which has been copied by many authors. It was spelled *cantala* in the original description by Roxburgh.)

The different confusing commercial names of the different fibers are given in first part of this paper.

MICROSCOPIC CHARACTERS OF THE FIBER CELLS

A. WALL THICKNESS GREATER THAN DIAMETER OF LUMEN[1]

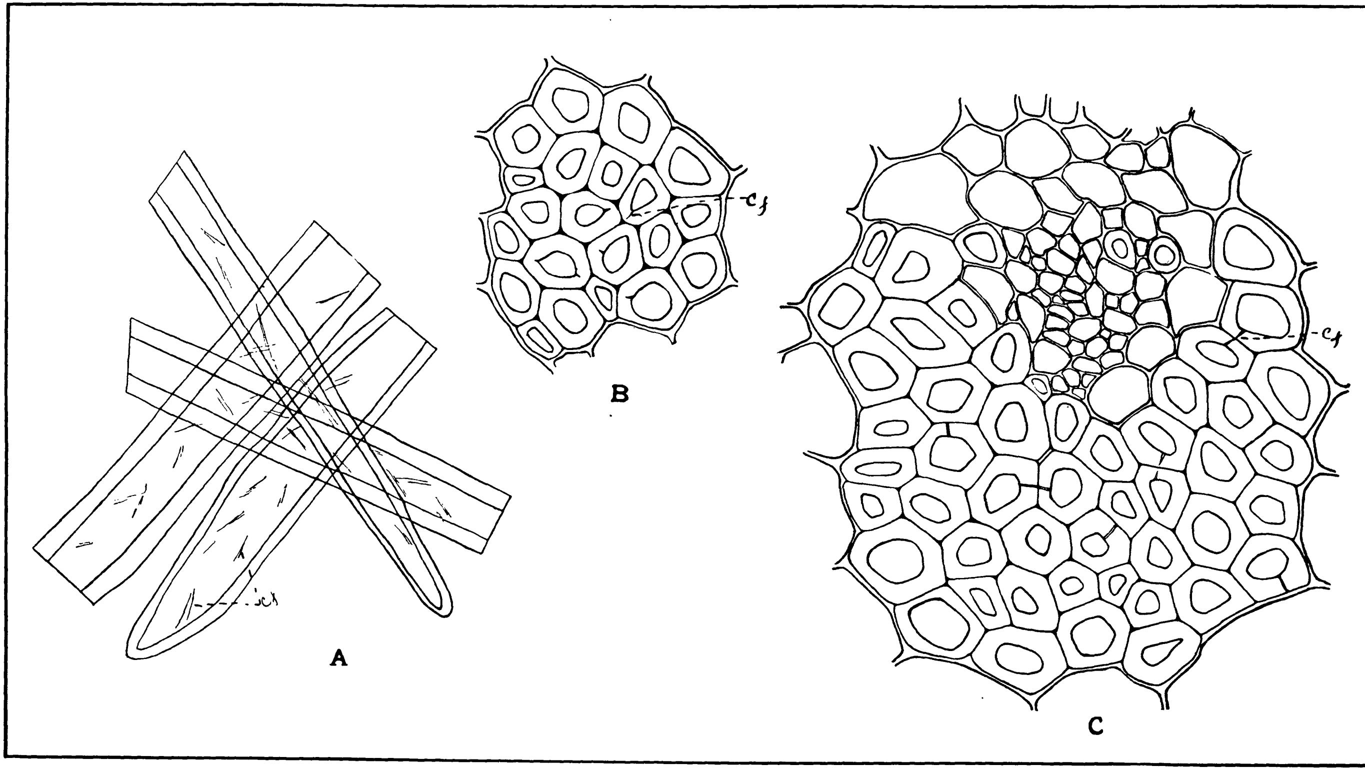
			mm.		*mm.*		*mm.*
(1)	Length	from	1.6565	to	5.6798	average	2.7595
	Gross diameter	from	0.0104	to	0.0252	average	0.0157
	Diameter of lumen	from	0.0011	to	0.0084	average	0.0041
	Thickness of wall	from	0.0043	to	0.0080	average	0.0059

Fiber cells not very tapering, end rounded, no crack-like fissures, no fiber strand without conducting tissue, Maguey.

			mm.		*mm.*		*mm.*
(2)	Length	from	1.4593	to	3.8195	average	2.1841
	Gross diameter	from	0.0106	to	0.0222	average	0.0154
	Diameter of lumen	from	0.0004	to	0.0059	average	0.0036
	Thickness of wall	from	0.0042	to	0.0082	average	0.0082

[6] DEWEY, L. H. The Identity of Fiber-Agaves. West Indian Bulletin, Vol. XVI, No. 2, 104–110. 1917.

[1] The figures are taken from Table II, considering the measurements of the cells from both strands from each fiber species as a whole.



"Turcroea gigantea" (Mauritius hemp). A, single fiber elements; B, cross section of smallest fiber strand; C, cross section of large fiber strand.

Fiber cells very tapering, end almost sharp, no crack-like fissures, with strand without conducting tissue, Zapupe.

B. WALL THICKNESS LESS THAN DIAMETER OF LUMEN

		mm.		mm.		mm.
(1) Length	from	1.2884	to	4.6932	average	2.6364
Gross diameter	from	0.0128	to	0.0205	average	0.0168
Diameter of lumen	from	0.0045	to	0.0123	average	0.0079
Thickness of wall	from	0.0030	to	0.0082	average	0.0054

Fiber cells not very tapering, end frequently forming sharp outline, no crack-like fissures, no fiber strand without conducting tissue cross section of small fiber strands showing larger number of fiber cells than the others, Sisal.

		mm.		mm.		mm.
(2) Length	from	1.2443	to	4.0352	average	2.2767
Gross diameter	from	0.0024	to	0.0218	average	0.0176
Diameter of lumen	from	0.0096	to	0.0419	average	0.0224
Thickness of wall	from	0.0033	to	0.0066	average	0.0051

Fiber cells not very tapering, end frequently with sharp outline, with crack-like fissures which are seen very prominently in cross section, with fiber strand without conducting tissue, Henequen.

		mm.		mm.		mm.
(3) Length	from	1.4173	to	4.3473	average	3.0479
Gross diameter	from	0.0166	to	0.0538	average	0.0329
Diameter of lumen	from	0.0096	to	0.0419	average	0.0224
Thickness of wall	from	0.0033	to	0.0066	average	0.0051

Fiber cells very large, wall very thin in comparison with lumen, crack-like fissures present, and not sharp, with strand without conducting tissue, Mauritius hemp.

APPENDIX

CLASIFICACIÓN, ENFARDAJE E INSPECCIÓN DE FIBRAS DE FILIPINAS

PARTE I

ORDEN ADMINISTRATIVA No. 25

REGLAMENTOS SOBRE LA CLASIFICACIÓN, ENFARDAJE E INSPECCIÓN DE FIBRAS DE FILIPINAS

De conformidad con lo provisto en la Sección III, Capítulo 46, Título VII, del Libro II, del Código Administrativo Revisado, por la presente se estatuyen las siguientes reglas sobre ciertas fases de la graduación, enfardaje e inspección de fibras filipinas para la información y guía de todos los interesados:

Este reglamento abarca las siguientes materias, a saber: (1) designación de los grados que han de servir de normas oficiales de todas las fibras incluídas en la Sección III, Capítulo 46, Título VII, del Libro II, del Código Administrativo; (2) determinación de los grados y tipos standard de las mismas; (3) reglas adicionales relativas al enfardaje, rotulación e inspección; y (4) cancelación de las reglas anteriores que estén en pugna con las provisiones de la presente orden.

SECCIÓN I.—*Designación de los grados que han de servir de normas oficiales*

Las fibras filipinas que se nombran a continuación se incluyen en este reglamento, estableciendo para cada una de ellas una serie particular de grados standard:

(1) Abacá (*Manila hemp*): De excelente limpieza y preparado especialmente para hacer trenzas tagal o para otros fines en que se emplean fibras finas.

(2) Abacá (*Manila hemp*): De limpieza excelente o buena.

(3) Tiras de abacá (*Manila hemp*): Fibras limpiadas parcialmente.

(4) Abacá (*Manila hemp*): Fibras leñosas y de desecho.

(5) Maguey o Sisal: Enriado.

(6) Cantala (Maguey) o Sisal: Extraído a cuchilla o a máquina.

(7) Pacol y Cantón.

ARTÍCULO 1. *Abacá (Manila hemp)—De excelente limpieza y preparado especialmente para hacer trenzas tagal o para otros fines en que se emplean fibras finas.*—Los siguientes grados constituirán las normas oficiales en la clasificación de esta fibra solamente cuando el producto esté cuidadosamente seleccionado; sea libre de toda estopa; su color, limpieza y textura sean más uniformes que lo que requieren las demás normas.

Designación por letras	Nombre del grado
AA	Tagal-uno.
BB	Tagal-dos.
CC	Tagal-tres.
DD	Tagal-cuatro.
EE	Tagal-cinco.

ART. 2. *Abacá (Manila hemp)—De limpieza excelente o buena.*—Los siguientes grados constituirán las normas oficiales en la clasificación de esta clase de fibra solamente cuando el producto esté en forma de fibra, esto es, cuando esté bien limpiado.

Designación por letras	Nombre del grado
A	Extra prime.
B	Prime.
C	Superior current.
D	Good current.
E	Midway.
S1	Streaky No. 1.
S2	Streaky No. 2.
S3	Streaky No. 3.
F	Current.
G	Seconds.
H	Brown.

ART. 3. *Tiras de Abacá (Manila hemp)—Fibras limpiadas parcialmente.*—Habrá seis grados de abacá cuando la fibra se prepara en forma de tiras que serán designados como sigue:

Designación por letras	Nombre del grado
I	Good Fair.
J1	Fair No. 1.
J2	Fair No. 2.
K	Medium.
L	Coarse Brown.

ART. 4. *Abacá (Manila hemp)—Fibras leñosas y de desecho.*—Habrá nueve grados de abacá cuando la fibra es dura y leñosa, esta deteriorada o en forma de ovillo, estopa o desecho, que se designarán como sigue:

Designación por letras	Nombre del grado
DL	Daet Coarse.
DM	Daet Coarse Brown.
O	Strings (white and fine).
OO	Strings (coarse or dark).
T	Tow (white and fine).
TT	Tow (coarse or dark).
Y	Damaged (fine fiber).
YY	Damaged (coarse fiber).
W	Waste.

ART. 5. *Maguey o Sisal—Enriado.*—Habrá cinco grados de maguey o sisal cuando las fibras se separan enriándolas en agua. Estos grados se designarán como sigue:

Designación por letras	Nombre del grado
Mgy o Ssl 1	Maguey o Sisal No. 1.
Mgy o Ssl 2	Maguey o Sisal No. 2.
Mgy o Ssl 3	Maguey o Sisal No. 3.
Mgy o Ssl Y	Maguey o Sisal Damaged.
Mgy o Ssl W	Maguey o Sisal Waste.

ART. 6. *Cantala (Maguey) o Sisal—Extraído a cuchilla o a máquina.*—Los grados del cantala o sisal cuando las fibras se extraen a máquina o a cuchilla serán siete, designados como sigue:

Designación por letras	Nombre del grado
Cla o Ssl A	Cantala o Sisal, good.
Cla o Ssl B	Cantala o Sisal, fair.
Cla o Ssl C	Cantala o Sisal, common.
Cla o Ssl R	Cantala o Sisal, red.
Cla o Ssl S	Cantala o Sisal, very short.
Cla o Ssl Y	Cantala o Sisal, damaged.
Cla o Ssl W	Cantala o Sisal, waste.

ART. 7. *Pacol y Cantón.*—Estas fibras se producen en ciertas partes de las Islas Filipinas, obteniéndose de plantas que se conocen por estos mismos nombres y se parecen al abacá y al plátano. Si bien el Cantón es mucho más fuerte que el Pacol, ambos son mucho más flojos que el abacá y la adulteración del uno con el otro y la mezcla de cualquiera de ellos o de ambos con el abacá están absolutamente prohibidas.

El Pacol se clasificará en Pacol No. 1 (Pcl 1), las fibras bien limpiadas (blancas u obscuras), y en Pacol No. 2 (Plc 2), las tiras o fibras parcialmente limpiadas.

Habrá tantos grados de Cantón como hay de abacá (*Manila hemp*), pero las designaciones por letras siempre han de estar precedidas de la palabra ' Cantón," como "Cantón F," etc., en el caso de la fibra de Cantón.

La base de la clasificación de la fibra de Cantón será la misma que la adoptada para el abacá, para los mismos grados, o sea, el color y la limpieza principalmente.

Las fibras arriba mencionadas se clasificarán bajo números de lote distintos de los del abacá y otras fibras, y el inspector de fibras expedirá por separado certificados para las mismas.

La fibra de abacá que se ha adulterado con fibra de Cantón o de Pacol, de suerte que es impracticable separar a las dos, se graduará como Cantón o Pacol sin tener en cuenta el percentaje de fibra pura de abacá que esté mezclado con cualquiera de estas dos clases inferiores de fibras.

Todos los fardos de fibra de Cantón o Pacol llevarán impresa sobre los mismos en tipos de tres pulgadas de alto, por lo menos, la palabra "Cantón" o "Pacol," además de la designación por letras de la clasificación oficial y de la marca del Gobierno que aparece en la etiqueta de muselina en el fardo.

SECCIÓN II.—*Designación de los grados y tipos*

La clasificación de las fibras en normas incluídas en la Sección I de esta orden se basará en la fuerza textil, color y limpieza de todas ellas, excepto las fibras de Pacol y Cantón, cuya clasificación se fundará principalmente en el color y limpieza, como sigue:

Fuerza textil.—Esta es una cualidad básica, y bajo este sistema las fibras deberán tener una resistencia media a la ruptura con el fin de que las mismas puedan clasificarse en cualquiera de las normas establecidas en esta orden; de lo contrario, se clasificarán como "averiadas," independientemente de su color o limpieza. Si la proporción de fibra floja o averiada en un lote no es suficientemente alta que justifique su clasificación en fibra averiada, entonces el único recurso será la repudiación del lote entero para separar la fibra floja de la de fuerza textil ordinaria.

Por lo regular, bastan la observación práctica y las pruebas a mano para saber si una fibra determinada posee o no la fuerza textil ordinaria. En caso de duda o discusión, sin embargo, el inspector de fibras verificará el resultado de sus observaciones, haciendo ensayos con máquinas adecuadas para probar la fuerza textil provistas al efecto por el Gobierno.

Color.—Si un lote de fibras posee la debida fuerza textil, la operación práctica de clasificar debe fundarse en el color. Esta cualidad es, por lo tanto, el factor determinante para clasificar abacá bien limpiado y cantala (maguey) y sisal extraídos a cuchilla o a máquina. El color de la fibra de abacá varía de pardo o morado a blanco, y la variación permisible entre un grado y otro se ilustra con muestras *standard* preparadas por la División de Fibras de la Oficina de Agricultura. Estas muestras pueden obtenerse por los clasificadores y compradores previo el pago por adelantado de ₱1 por cada muestra.

Limpieza.—El método o grado de limpieza (extracción de la fibra) muchas veces produce cambios radicales en el caracter y utilidad de la fibra, de ahí el establecimiento de una serie separada de grados *standard* para las tiras de abacá y de otra para el maguey y sisal enriados.

En los grados incluídos en estas dos series de normas, el grado de limpieza es el factor determinante, si bien debe tenerse en cuenta también el color.

Para describir la limpieza de la fibra en los certificados de inspección se usarán los siguientes términos:

"Excellent" (excelente), cuando la limpieza es perfecta o casi lo es, y el producto es fibra pura, como en los grados tagal (*véase* el artículo I, Sec. I) y también en los grados "Extra Prime" a "Streaky No. 3" (*véase* el artículo 2, Sec. I); en los grados "Cantala o Sisal A" a "S" (extraído a cuchilla o a máquina) (*véase* al artículo 6, Sec. I); y en los grados "Maguey o Sisal No. 1" (*véase* el artículo 5, Sec. I).

"Good" (buena), en el caso del abacá, cuando el producto contiene tiras, pero estas son finas, blandas y están más o menos entremezcladas con fibra pura, como en los grados "Current," "Seconds," "Brown" y a veces "Good Fair;" y en el caso del maguey y sisal enriados, cuando la fibra está algo salpicada de escamas duras y gomosas, como en el grado "Maguey o Sisal No. 2."

"Fair" (regular), en el caso del abacá cuando el producto contiene muchas tiras, pero estas son estrechas y delgadas, como en los grados "Good Fair," "Fair No. 1," "Fair No. 2" y "Medium," y en el caso del maguey o sisal enriados, cuando las escamas gomosas en la fibra se ven más o menos claramente, como en los grados "Maguey o Sisal No. 3."

"Coarse" (basta), cuando el producto es todo tiras y éstas son anchas, carnosas, o las dos cosas, como en los grados "Coarse," "Coarse Brown" y en los dos grados de Daet.

Además de la fuerza textil, color y grado de limpieza, hay otras dos características en una fibra que no afectan a su grado pero que son muchas veces consideradas como necesarias para identificar su tipo en cualquiera de los grados. Éstas son la *textura* y la *longitud.*

La *textura* de una fibra varía en muchos casos según su limpieza. La fibra es, por consiguiente, designada "Soft" (blanda), "Medium" (mediana) o "Hard" (dura), según que la limpieza es "Excellent" (excelente), "Good" (buena), o "Fair" (regular), o "Coarse" (basta). Algunas variedades de abacá en el Norte y Sur de Mindanao producen una fibra que

por su naturaleza es de textura mediana o dura, si bien puede ser de excelente limpieza.

Por su *longitud*, la fibra de abacá será designada "very long (muy larga), cuando excede de 3 metros (10 pies); "long" (larga), cuando es de 1½ a 3 metros (de 8 a 10 pies); "normal," cuando es de 1½ a 2½ metros (de 5 a 8 pies); "short" (corta), cuando es menos de 1½ metros (5 pies).

La fibra de Maguey y Sisal será designada "long (larga), cuando es de 1 metro (40 pulgadas) o más de largo; "normal," cuando es de 60 centímetros a 1 metro (de 24 a 40 pulgadas); "short" (corta), cuando es de 50 a 60 centímetros (de 20 a 24 pulgadas); y "very short" (muy corta). cuando es menos de 50 centímetros (20 pulgadas), sin tener en cuenta el color ni la limpieza.

SECCIÓN III.—*Enfardaje, Rotulación e Inspección*

Las siguientes reglas adicionales referentes al enfardaje, rotulación e inspección de fardos deberán observarse por todos los establecimientos de graduación.

ARTÍCULO 1. Cada madeja en un fardo de fibra para fines de cordaje no deberá exceder de 12 ni ser menos de 6 centímetros de diámetro antes de ser prensada, pero en un fardo para trenzas tagal la madeja podrá ser menos de 6 centímetros de diámetro.

Todos los fardos deberán estar libres de ovillo, desecho, estopa, fibra averiada, de fibra que no es idéntica a la que compone el fardo, o de toda sustancia extraña, y la fibra deberá estar completamente seca.

Todas las madejas de fibra en un fardo deberán ser uniformes en calidad y cada una de ellas deberá asimismo estar bien amarrada con un cordón para que las fibras se mantengan juntas, debiendo ser el cual cordón de fibra idéntica a la que compone el fardo. La manera de amarrar la madeja sin formar nudo y el tamaño del cordón que se ha de usar se ilustran en las muestras *standard.* Ninguno de los dos extremos del cordón deberá anudarse.

ART. 2. Las dimensiones de cada fardo de los grados "Tagal-uno" a "Tagal-cinco," inclusive, podrán aumentarse en no más de 40 por ciento sobre las medidas prescritas en el artículo 1783 del Código Administrativo (Ley 2711).

ART. 3. La división de cada madeja en dos o tres partes, y el entretejer estas partes como los cabos de una cuerda están prohibidos. Sin embargo, la madeja podrá entretejerse entera una o dos veces o lo necesario para mantener juntas las fibras.

ART. 4. Las madejas se colocarán derechas y por capas en el fardo, alternando las cabezas de una capa con las puntas de la otra. No deberán doblarse las madejas sobre si mismas más de lo absolutamente necesario.

ART. 5. Cada fardo de fibra se asegurará bien con no más de ocho amarres en los lados y cuatro en las cabezas hechos de la misma clase de fibra que compone el fardo, o de bejuco. Los últimos amarres deberán distar, por lo menos, 10 centímetros de los extremos. (*Véase* la Fig. 1.).

ART. 6. Todas las fibras clasificadas se dividirán en lotes. Las fibras de cada lote serán del mismo tipo, pero pueden ser de más de un grado. Los lotes deberán ser numerados consecutivamente y se dará a cada establecimiento de graduación una serie de números juntamente con la licencia, pudiendo repetirse la numeración si se acaba. La inspección de cada cargamento de fibra que se embarque se hará por lotes separados, y se dará

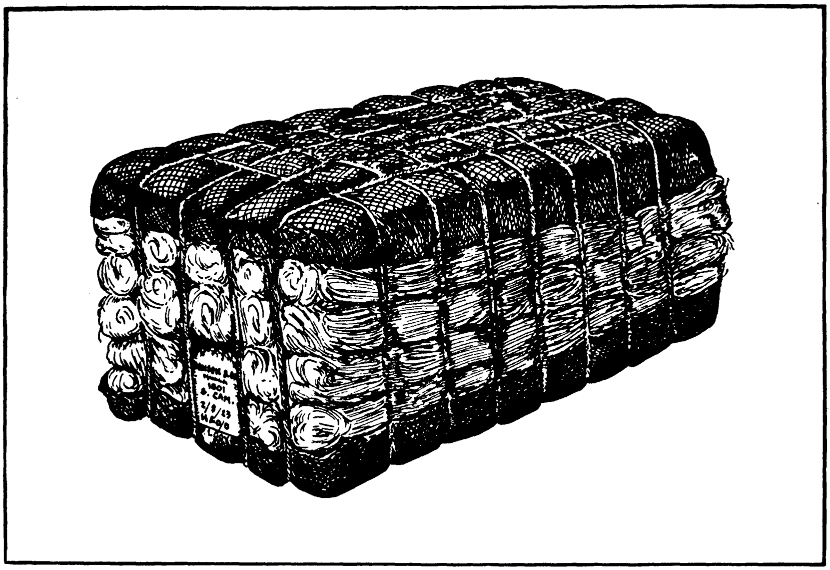


FIG. 1. Fardo hecho demostrando la manera de envolver, amarrar y poner la etiqueta.

distintos certificados de inspección por cada lote inspeccionado. Un lote de fibra se considerará bajo inspección hasta que todos los fardos de todos los grados incluídos en el mismo hayan sido marcados y se haya expedido el correspondiente certificado de inspección.

A fin de evitar confusiones innecesarias y obtener uniformidad de tipos, se llama la atención de los clasificadores hacia la necesidad de dividir los lotes de tal manera que la fibra en cada lote no proceda más que de una provincia o distrito. De lo contrario, el arreglo de los lotes produciría molestias y gastos innecesarios al clasificador.

Con el objeto de facilitar la división de la fibra en lotes de tipo uniforme, las provincias abacaleras de las Islas Filipinas se dividirán en los siguientes distritos y los productos de cada uno de ellos podrán considerarse de tipo uniforme e incluirse en un lote:

Provincia o Isla	Distrito	Abreviaturas
Camarines Norte	Camarines Norte	N. Cam.
Camarines Sur	Camarines Sur	S. Cam.
Albay	Albay (incluyendo Catanduanes)	Albay.
Sorsogón	Sorsogón Norte	N. Sor.
	Sorsogón Sur	S. Sor.
Sámar	Sámar Norte	N. Sam.
	Sámar Sur	S. Sam.
Leyte	Este de Leyte	E. Ley.
	Oeste de Leyte	W. Ley.
Isla de Mindanao	Mindanao Norte	N. Min.
	Mindanao Sur	S. Min.

Las provincias restantes que producen abacá se considerarán cada una como distrito separado.

A fin de facilitar la identificación del establecimiento de enfardaje en que un fardo o fardos de un lote se han prensado, las siguientes esta-

ciones de clasificación se conocerán por los siguientes iniciales permanentes que se antepondrán a la marca de prensa separados por una barra inclinada:

Baybay	(Leyte)—B
Borongan	(Sámar)—BO
Bulan	(Sorsogón)—BU
Cagayán	(Misamis)—K
Calbayog	(Sámar)—CA
Carigara	(Leyte)—CR
Casiguran	(Sorsogón)—CS
Catarman	(Sámar)—CM
Catbalogan	(Sámar)—CT
Cebú	(Cebú)—C
Daet	(Camarines Norte)—D
Dávao	(Dávao)—DA
Daliaoan	(Dávao)—DL
Donsol	(Sorsogón)—DS
Goa	(Camarines Sur)—GO
Gubat	(Sorsogón)—G
Iloílo	(Iloílo)—I
Iriga	(Camarines Sur)—IR
Lagonoy	(Camarines Sur)—LA
Laoang	(Sámar)—LN
Legaspi	(Albay)—L
Ligao	(Albay)—LI
Maasin	(Leyte)—MA
Malita	(Dávao)—ML
Malitbog	(Leyte)—MG
Manila	(Manila)—M
Masbate	(Masbate)—MS
Mati	(Dávao)—MI
Matnog	(Sorsogón)—MT
Mauban	(Tayabas)—MU
Naga	(Camarines Sur)—N
Nato	(Camarines Sur)—TN
Palompon	(Leyte)—P
Sagnay	(Camarines Sur)—SY
San José	(Camarines Sur)—CI
Sorsogón	(Sorsogón)—S
Surigao	(Surigao)—SU
Tabaco	(Albay)—T
Tacloban	(Leyte)—TL
Talomo	(Dávao)—TO
Tigaon	(Camarines Sur)—TI
Vigan	(Ilocos Sur)—V
Virac	(Catanduanes)—VC
Zamboanga	(Zamboanga)—ZZ

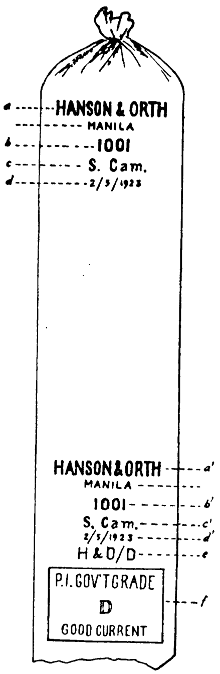


Fig. 2. La etiqueta de tela demostrando *(a, a')* el nombre del establecimiento de graduación; *(b, b')* el número del lote; *(c, c)* el nombre en abreviatura del distrito de producción; *(d, d')* la fecha del prensaje; *(e)* el nombre de la estación de graduación, la marca de prensa y la designación por letras del grado, los tres formando una sola marca; y *(f)* la marca del Gobierno dando el nombre entero del grado.

ART. 7. Cada fardo de fibra llevará una etiqueta de tela blanca de algodón y sin almidón, no menos de 75 centímetros de largo, ni menos de 10 centímetros de ancho. Un extremo de esta etiqueta se colocará en medio o cerca del medio del fardo, y el otro extremo estará a unos 12 centímetros fuera del extremo del fardo y deberá ser claramente visible. (*Véase* la Fig. 1.) El extremo de la etiqueta que está dentro del fardo deberá amarrarse a una de las madejas en medio del fardo e inmediatamente debajo de la atadura estará escrito el nombre entero o en abreviatura del establecimiento de graduación, el número del lote, el nombre entero o en abreviatura de la provincia o distrito de producción, y la fecha del prensaje. (*Véase* la Fig. 2, a, b, c, d.) El extremo que sale fuera del fardo se di-

vidirá en dos secciones, ostentando la sección adyacente al fardo los mismos datos estampados en el extremo que está dentro del fardo, incluyendo la fecha del prensaje, al paso que la sección exterior ostentará el nombre en abreviatura de la estación de graduación juntamente con la marca de prensa y la designación oficial por letras del grado, los tres separados por barras pero formando una sola marca, y debajo de ésta la marca del Gobierno dando el nombre entero oficial del grado. (*Véase* Fig. 2, a', b', c', d', e, f.)

Las letras y números escritos en la etiqueta de tela que se menciona en este artículo no deberán tener menos de 1 centímetro de alto.

Sobre los petates que cubren las dos superficies del fardo se estampará con tinta indeleble la misma marca que aparece en la etiqueta de tela fuera del fardo.

SECCIÓN IV.—*Cancelación de las reglas anteriores que estén en pugna con la presente orden*

Esta orden tendrá efecto después de transcurridos seis meses desde la fecha de su aprobación por el Secretario de Agricultura y Recursos Naturales.

Todas las reglas anteriores que estén en pugna con esta Orden Administrativa quedan por la presente derogadas.

(Fdo.) ADN. HERNÁNDEZ
Director de Agricultura

Aprobada, abril 2, 1923.

(Fdo.) RAFAEL CORPUS
Secretario de Agricultura
y Recursos Naturales

PART II

LA FUERZA DE LAS FIBRAS DURAS

Las fibras de abacá (*Manila hemp*), maguey y sisal pertenecen a uno de los dos grupos naturales de fibras largas conocidas por fibras duras. Las fibras largas constituyen dos grupos naturales: (1) fibras blandas, o fibras para cuerdas, tales como el lino, el cáñamo, el yute y la ramina; y (2) fibras duras, tales como el abacá (*Manila hemp*), el maguey, el sisal, el henequen y el lino de Nueva Zelandia.

Las hebras de las fibras blandas varian mucho en grosor y ordinariamente se pegan unas con otras de tal manera que es casi imposible escoger hebras separadas para la comparación. Las fibras duras, sin embargo, a las que pertenecen las fibras de abacá (*Manila hemp*), sisal y maguey presentan hebras simples que son suficientemente uniformes y libres de hebras adhesivas para ser escogidas para la ruptura, más no son bastante uniformes para ser comparadas directamente. Una fibra dura y basta puede que se rompa a una fuerza de tensión mayor que una fibra fina, pero la fibra fina puede ser mucho más fuerte cuando se compara con una fibra basta de igual grosor o peso. El peso es más satisfactorio para la comparación que el diámetro o el grosor y se determina más facilmente. Por lo tanto, para la comparación la fuerza de ruptura de cada muestra se computa a base de un tipo de fibra conveniente pero arbitrario que pesa 1 gramo por cada metro de longitud.

Para probar las fibras duras arriba mencionadas se sigue el siguiente método:

Se escogen diez fibras de la muestra y se mide su longitud y después se pesan. Luego se rompen en la máquina de prueba. La fuerza de ruptura dividida por el peso por cada metro da la fuerza de ruptura en gramos por cada metro.

Lo siguiente es la fuerza media de tensión de no menos de diez ensayos hechos con diferentes grados de fibras de abacá (*Manila hemp*), sisal y maguey de distintos distritos de producción:

ABACÁ (MANILA HEMP)

Grado	Fuerza de ruptura en gramos por cada metro	Grado	Fuerza de ruptura en gramos por cada metro
	Gramos		*Gramos*
A	49,304	G	47,057
B	48,889	H	47,029
C	50,559	I	46,351
D	52,075	J	45,553
E	50,240	K	41,012
S1	52,670	L	35,912
S2	52,861	M	40,350
S3	52,873	DL	33,873
F	52,415	DM	30,472

MAGUEY (ENRIADO) | SISAL (ENRIADO)

Grado	Fuerza de ruptura en gramos por cada metro	Grado	Fuerza de ruptura en gramos por cada metro
	Gramos		*Gramos*
Mgy 1	23,249	Ssl 1	22,734
Mgy 2	24,066	Ssl 2	26,173
Mgy 3	23,668	Ssl 3	21,966

CANTALA (O MAGUEY EXTRAÍDO A MÁQUINA) | SISAL (EXTRAÍDO A MÁQUINA)

Grado	Fuerza de ruptura en gramas por cada metro	Grado	Fuerza de ruptura en gramos por cada metro
	Gramos		*Gramos*
Cla A	26,005	Ssl A	30,778
Cla B	26,798	Ssl B	32,181
Cla C	25,812	Ssl C	28,304
Cla R	21,409		

Los varios grados diferentes de abacá (*Manila hemp*) que son reconocidos en el mercado se deben principalmente a las distintas cuchillas (llanas o dentelladas) que se usan en la extracción de la fibra y, por lo tanto, esta fibra presenta una gran variación en el peso por cada metro y en la fuerza por el mayor o menor cuidado que se tiene en ajustar la cuchilla.

Las anteriores cifras como son promedios de diez o más ensayos no representan los límites extremos.

PARTE III

DESCRIPCIÓN DE LOS GRADOS CLASIFICADOS COMO STANDARD DE LA FIBRA DE ABACÁ ("MANILA HEMP")

El número y la designación de los grados oficiales clasificados como *standard* de las principales fibras comerciales de las Islas Filipinas se dan en el Artículo I de la Orden Administrativa No. 25 de la Oficina de Agricultura. En la Sección II de esta orden se explican las principales características que en cada una de las fibras incluídas en los reglamentos determinan el grado y su tipo, pero no se ha hecho ninguna tentativa de describir específicamente cada grado. El objeto de este artículo es dar tal descripción, basándola en las cualidades aparentes de la fibra de cada grado y en las variaciones que puedan encontrarse respecto al carácter de la fibra en los diferentes distritos donde se produce.

Semejante descripción es difícil de hacer en el caso del abacá, tal vez más que en el de cualquier otra clase de fibra dura, y se supone que antes de entender bien esta descripción el lector ya tiene un conocimiento práctico de los grados comerciales de esta fibra. Es verdad que un conocimiento cabal de los grados del abacá puede obtenerse solamente por medio de un examen y manejo de la fibra en una escala más o menos extensa. Ocurre lo mismo en el caso de casi todas las demás fibras, si bien el abacá presenta una dificultad particular por razón de los métodos variables que se usan en su preparación y en su manejo preliminar. A pesar de todas

estas dificultades, se cree que una descripción especifica de los grados, tal como se propone en este artículo, aunque no pueda ser inteligible al seglar, puede ser una valiosa ayuda para todas las personas que han tenido experiencia con las fibras de Filipinas.

Para los fines de esta sección, los grados *standard* del abacá se clasifican en cuatro grupos, según el grado de limpieza de la fibra. Los grados de cada grupo se describirán por separado, comenzando por el grado más bajo. De este modo, se demuestran lo más claramente posible las gradaciones que existen en sus características aparentes.

GRADOS STANDARD DEL ABACÁ ("MANILA HEMP")

GRUPO I.—*Los de limpieza excelente*

Los grados incluídos en este grupo son desde "Extra prime" hasta "Streaky No. 3," excluyendo el "Current," el cual es con más frecuencia de limpieza buena que excelente. En estos grados la limpieza es perfecta, o casi lo es, y el producto es casi todo fibra pura, por cuya razón la textura es generalmente blanda (excepto la fibra que se produce en el Sur y Norte de Mindanao, que a veces es *mediana* en textura) y el promedio de fuerza textil es muy alto. Mientras los grados de este grupo se producen con más o menos abundancia en todas las provincias, constituyen la mayor parte de la producción solamente en Cavite, Mindoro, el Sur de Mindanao (Provincia de Dávao), Sámar, el Oeste de Leyte, Tayabas (Marinduque) y Panay (Cápiz e Iloílo).

Streaky No. 3.—Este grado se produce enteramente de las capas exteriores de ciertas variedades de abacá, cuyo color natural es obscuro. Por esta razón, el *color* predominante de la fibra es morado claro con sólo pocas rayas de blanco obscuro que corren a lo largo de la fibra. El color de la fibra del medio hacia la punta es ordinariamente más obscuro que la parte que queda. En este grado, la fibra es invariablemente corta y raras veces excede de 1.25 metros (4 pies) de *largo.*

Streaky No. 2.—Este grado se produce de las capas que siguen a las de la parte exterior del tallo del abacá de las mismas variedades de las cuales se produce el "Streaky No. 2," o de las capas exteriores de otras variedades en que los tallos son naturalmente de color más claro. El *color* de esta fibra es una mezcla, en proporciones más o menos iguales, de blanco y rojo obscuros, o morado claro. La fibra es casi invariablemente corta y raras veces excede, si es que alguna vez excede, de 1.5 metros (5 pies) de *largo.*

Streaky No. 1.—Este grado se produce también de las pocas capas que siguen a las exteriores del tallo del abacá. Estas capas son un poquito más largas y de menos color que las exteriores, de ahí que el *color* predominante de la fibra es amarillo de marfil claro u ocre claro, mezclado con unas cuantas rayas o estrías de un color rojizo claro. La fibra es por lo regular corta, aunque a veces se encuentran fibras de longitud ordinaria.

Midway.—Este grado se obtiene por regla general de las capas del medio del tallo del abacá que son de un color ocre claro y que se extienden a lo largo de toda la longitud del tallo. No se nota en este grado el color morado o rojo en cantidades notables, y la longitud de la fibra depende enteramente del grado de desarrollo de la planta. En el grado típico, el *color* característico de la fibra puede decirse que es ocre, entremezclado

con frecuencia con rastros de color amarillo de marfil claro que pertenece en realidad al grado inmediatamente superior. La proporción de la fibra "Midway" en el tallo del abacá, cuando la fibra se limpia y se seca cuidadosamente, no excede del 10 al 15 por ciento. Esto prueba que la mayor parte de la producción de este grado en tales provincias como Sámar, Leyte y Norte de Mindanao no puede ser enteramente típica. Una gran proporción de fibra "Midway," tal como se encuentra generalmente en el mercado, no es más que fibra "Good current" que ha desmejorado en color debido a un método inadecuado de secar y manejar. Esta clase de fibra "Midway" puede distinguirse de la del grado típico por la falta de lustre que posee frecuentemente esta última.

La limpieza de la fibra "Midway" no es talmente excelente, pues muchas veces está ligeramente mezclada con tiras, semejándose a la fibra "Current." En tales casos, empero, las tiras son ordinariamente blandas y finas y tienen un color subido que casi iguala al del "Good current." La fibra "Midway" de Sorsogón, Albay y Camarines son con frecuencia de esta naturaleza.

Good current.—El color predominante de la fibra de este grado es ocre muy claro, entremezclado con una cantidad considerable de fibras de color amarillo de marfil claro. La *longitud* de la fibra es normal, esto es, la fibra es larga, dependiendo enteramente del grado de desarrollo de la planta. La textura es generalmente blanda, excepto en el caso de aquellas variedades de la planta que producen una fibra que es por naturaleza de textura dura o mediana.

Este grado es el más bajo de entre los que se llaman grados superiores. Será conveniente para la industria que la producción de esta fibra se aumente a expensas de algunos grados inferiores y entremezclados con tiras. Sin temor a equivocarse, se puede decir que en aquellas provincias en donde se emplean métodos más o menos modernos por los productores progresivos, el promedio de producción raras veces es menor que la de "Good current" y en algunos casos es hasta mayor.

Superior current.—El *color* de la fibra de este grado es amarillo de márfil claro y gran parte de la misma ordinariamente tira a blanco. En cuanto a *longitud, textura* y *limpieza* la fibra es esencialmente igual a la de "Good current" quizás un poquito más blanda y mejor limpiada en algunos casos.

Este grado, aunque figura en el tercer puesto respecto a la calidad, puede llamarse con seguridad superior para fines de cordaje, pues los grados "Prime" y "Extra prime" se usan solamente a este fin en muy pequeña escala. La producción de este grado es también por desgracia mucho más baja de lo que debería ser. Una parte bastante considerable de esta fibra se usa en el Japón para la fabricación de trenzas para sombreros, conocidas comúnmente por "tagal."

Prime y extra prime.—Estos grados constituyen el segundo y primero, respectivamente, de los grados superiores. Se describen juntamente porque sus características son casi las mismas en cuanto a la *textura, limpieza* y *longitud* de la fibra. El *color* de la fibra en ambos grados es casi blanco, aunque es algo más pronunciado en el "Extra prime." Estos dos grados se obtienen de las capas interiores que envuelven el centro del tallo del abacá. Estas capas son por naturaleza más blancas, más blandas y un poquito más cortas que aquéllas que las rodean. Por esta razón, la tex-

tura es siempre blanda, prescindiendo de la variedad de la planta o del distrito de producción.

La mejor fibra de estos grados viene de las Provincias de Cavite, Dávao y Camarines. En efecto, estas provincias producen la mayor parte de esta clase de fibra. Hasta ahora la mayor parte de la producción de estos dos grados se exporta al Japón para usarse en la fabricación de trenzas tagal, por las cuales se pagan precios más altos que los que posiblemente pueden pagar las fábricas cordeleras.

GRUPO 2.—*Los de buena limpieza*

Los grados comprendidos en este grupo son el "Current," el "Seconds" y el "Brown." El grado "Good fair," tal como se produce en Sámar, en el Oeste de Leyte y en unas cuantas provincias o distritos más que producen los llamados grados blandos, está incluído en este grupo, pero este grado generalmente pertenece al grupo siguiente, en donde se describirá.

En estos grados la limpieza no es perfecta y el producto está por lo regular en forma de tiras muy finas y blandas, o es una mezcla de fibra pura y tiras finas y blandas, las cuales pueden considerarse para todos los usos prácticos como fibra, siendo esta última forma quizás la más predominante. Por esta razón, la limpieza se describe generalmente como "buena," y la textura como "mediana."

Brown.—Éste es el grado más bajo de este grupo. Su *color* es ordinariamente pardo obscuro o moreno, siendo más pronunciado este color hacia las puntas de la fibra, debido al hecho de que las puntas de las capas exteriores del tallo del abacá de que se produce son delgadas y por lo regular están en estado más o menos seco, haciendo difícil de esta manera la separación de la pulpa. El grado "Brown," tal como se produce en el Este de Leyte, es ordinariamente de un color más obscuro que el que se cosecha en la mayor parte de las otras provincias, a causa del predominio que allí tienen las variedades con tallos de color obscuro. La *textura* de la fibra suele ser *mediana* y su *longitud* corta.

A veces se encuentra este grado en fibras que son en si de grado más alto, pero que después debido a un descuido en el manejo y desecación se hacen obscuras. Esta clase de fibras es ordinariamente más larga que la del grado típico. Este grado corresponde al "Streaky No. 3" de los grados de limpieza excelente, con la diferencia en el grado de limpieza, que explica el color más obscuro y la textura relativamente más dura del grado "Brown."

Seconds.—Este grado se produce de las mismas capas del tallo del abacá de que se obtiene el "Streaky No. 2," con la misma diferencia en el grado de limpieza que entre el "Brown" y el "Streaky No. 3." El *color* de la fibra en el grado "Seconds" es, por lo tanto, una mezcla ordinariamente de verde claro y moreno claro, con las puntas generalmente más obscuras que el resto de ella, como los grados "Streaky" y "Brown." La longitud de la fibra en el grado típico es con más frecuencia corta que normal.

No siempre se debe al color natural del tallo el color mixto peculiar de este grado y del 'Brown" y "Streaky," sino que cualesquier daños considerables ocasionados al tallo, tales como los rasguños o la pudrición parcial por caídas o retraso en beneficiar la fibra, producen el mismo efecto u otro parecido. En este último caso, no obstante, el color más bien amarillo claro o rojo que moreno claro o verde.

Este grado se puede encontrar también en fibras que eran en si de grado superior, pero que debido a una limpieza y desecación inadecuadas se hicieron demasiado obscuras para aquel grado. El color de estas fibras difiere del color típico descrito arriba, pues es completamente rojo obscuro o moreno claro.

Current.—El color característico de este grado es tan difícil de describir como el de los grados "Midway" a "Extra prime." Es un matiz de moreno muy claro y es debido a la acción del ácido cuando se deja permanecer en la fibra por algún tiempo. Esto acontece con frecuencia cuando la fibra no se ha limpiado bien o no se ha secado enseguida después de su separación de la pulpa. La *textura* de la fibra es *mediana*, excepto en aquellos casos en que la fibra "Midway" ha desmejorado tanto en color que hay necesidad de clasificarla como "Current." Esta fibra se describirá como de blanda textura y limpieza excelente y ordinariamente se produce en Sámar, Leyte y en algunos distritos poco importantes, como Mindoro, Marinduque, Cebú y otros, en donde se cosecha la mayor parte de los grados superiores. La *longitud* de la fibra es normal o larga, produciéndose esta última principalmente en algunas de las provincias del Norte y Sur de Mindanao.

Este grado es indudablemente el más importante de todos los grados del abacá que son de limpieza buena y excelente. Su importancia no consiste en la calidad superior de la fibra, sino en la cantidad de la oferta y demanda de ella.

GRUPO 3.—*Los de limpieza regular*

Los grados comprendidos en este grupo son el "Good Fair," el "Fair No. 1," el "Fair No. 2" y el "Medium." En estos grados la limpieza se describe generalmente como regular y la textura como mediana o dura, siendo el producto todo tiras o tiras ligeramente mezcladas con fibras verdaderas. Los dos grados inferiores de este grupo son los grados superiores de las llamadas U. K. (*United Kingdom*) (Reino Unido), por razón de que casi todas las fibras de esta clase que se producen son compradas por fabricantes ingleses de cordaje.

Medium.—El *color* de la fibra de este grado varía de pardo claro a moreno obscuro, en otras palabras, incluye los colores de los grados *seconds* inferior y *brown.* La *longitud* de la fibra es ordinariamente corta en el grado típico y normal en las fibras que se preparan al principio como "Fair" pero que son reducidas después a este grado a causa de una desecación y manejo inadecuados.

Fair No. 2.—Este grado es el más alto de entre los llamados grados U. K., correspondiendo por regla general al grado "Fair Current U. K." y "Superior Seconds U. K." del antiguo *standard.* En *color* varía del de *seconds* superior al del *current* y en longitud es casi siempre normal y raras veces es larga o corta la fibra. El grado típico que viene de Albay o Camarines, que es de textura dura y de buen color, tiene más demanda en el comercio europeo.

En cuanto a producción, a este grado sólo aventaja el "Current."

Fair No. 1.—El color de la fibra de este grado es el del *seconds* superior. La fibra es relativamente blanda en *textura.* Este grado es más o menos equivalente al "Superior Seconds U. S." y 50 por ciento más que "Superior Seconds U. S." del antiguo *standard.*

Good Fair.—Por el método variable de limpiar la fibra de abacá en diferentes provincias se produce una gran cantidad de fibra que se considera

demasiado buena para el grado "Fair" y demasiado inferior para "Current." Su color, limpieza y textura también son tales que sería poco deseable que se incluyera en los "Seconds." Por estas razones, se ha considerado necesario establecer un grado distinto para esta fibra.

El grado típico de la fibra "Good fair" es de *limpieza* regular, *textura* dura y *color* corriente y se produce generalmente en Albay, Sorsogón y Camarines. Esta fibra "Good fair," tal como viene de Sámar, Leyte y otras provincias que producen casi todo grados superiores, es por regla general de buena limpieza y textura mediana, como el "Current," pero es demasiado inferior y obscura en color para poder ser incluída en este último grado. La longitud de la fibra es generalmente normal como en los grados "Current," "Fair No. 1" y "Fair No. 2."

GRUPO 4.—*Los de limpieza basta*

Los grados incluídos en este grupo son "Coarse," "Coarse brown," "Daet coarse" y "Daet coarse brown." La fibra en estos dos últimos grados se parece más bien a un material de paja que a una fibra verdadera, de ahí que su descripción se dará después de la de los dos primeros grados del *standard* ordinario. La fibra en los grados de este grupo está en forma de tiras puras y puede describirse como de *textura* dura y *limpieza* basta, variando ligeramente según los distintos distritos en que se produce.

Coarse brown.—Hablando con precisión, éste es el más bajo de entre los grados verdaderos. Su *color* es igual al del "Medium," variando del color del *seconds* inferior al del *brown;* en *textura* es siempre dura, aunque es relativamente más blanda en algunas provincias o distritos que en otros; y en *limpieza,* es siempre basta, siendo las tiras mucho más anchas y, por regla general, más gruesas que las del grado "Medium." La *longitud* de la fibra es corta o normal y con frecuencia mixta.

Coarse.—Éste es el grado más alto de este grupo. Su *color* es semejante al del "Fair" y varía del color del *seconds* superior al del "*Current.*" En *textura* y *limpieza* es idéntico al grado anterior.

Casi toda la producción de "Coarse" y "Coarse Brown" se exporta a la Gran Bretaña y otros países europeos, en donde son grados muy populares, no por ser de calidad superior, sino por razones económicas. El mejor tipo de estos grados se produce en Legaspi (Albay) y Lagonoy (Sur de Camarines).

Grados de Daet.—En *color* y *longitud* de la fibra, el "Daet coarse" y el "Daet coarse brown" son idénticos al "Coarse" y "Coarse brown," respectivamente. La limpieza de la fibra en los grados anteriores, sin embargo, es tan pobre y las tiras son tan anchas y gruesas que sólo con la ayuda de la imaginación puede considerarse como fibra. Por esta razón, estos grados han sido designados en la Orden Administrativa No. 25 bajo el *standard* de fibras leñosas. Este tipo de fibra se produce generalmente en Camarines, en los distritos de Tabaco y Virac, de Albay, y un poco en los distritos del Norte de Mindanao.

Es muy dudoso si se pueden utilizar con provecho los grados de Daet para cordajes, excepto quizás cuando se mezclan con los grados superiores. No puede haber duda de que la producción de este tipo de fibra ha dañado la reputación de nuestro abacá, y por esta y otras razones económicas de orden local, su producción no se debería continuar.

PARTE IV

DESIGNACIONES POR LETRAS, NOMBRES DE LOS GRADOS STANDARD Y SUS EQUIVALENTES EN LA CLASIFICACIÓN ANTIGUA

Designación por letras	Nombre del grado	Nombres antiguos
A	Extra Prime	F. E. A. quality-100 por ciento sobre good current
B	Prime	F. E. B. quality- 62½ por ciento y 75 por ciento sobre good current.
C	Superior Current	37½ por ciento y 50 por ciento sobre good current.
D	Good Current	Good current y 25 por ciento sobre good current.
E	Midway	Midway o 50 por ciento; 62½ por ciento y 75 por ciento sobre Fair current U. S.
S1	Streaky No. 1	Leyte Superior Seconds.
S2	Streaky No. 2	Leyte Good Seconds.
S3	Streaky No. 3	Leyte Fair Seconds.
F	Current	25 por ciento y 37½ por ciento sobre Fair current U. S.
G	Seconds	Soft y Medium Seconds U. S.
H	Brown	Soft y Medium Browns U. S.
I	Good Fair	Fair current y 12½ por ciento sobre Fair.
J1	Fair No. 1	Sup. seconds U. S. y 50 por ciento sobre Superior seconds U. S.
J2	Fair No. 2	Fair current U. K.; y Superior seconds U. K.
K	Medium	Medium browns U. K.; y Fair seconds U. K.
L	Coarse	Good seconds U. K.
M	Coarse Brown	Good browns U. K.; y Fair browns U. K.
DL	Daet coarse	Daet current; y Daet seconds.
DM	Daet coarse brown	Daet reds.
Y	Damaged (fine fiber)	
YY	Damaged (coarse fiber)	
O	Strings (white and fine)	
OO	Strings (dark and coarse)	
T	Tow (white and fine)	
TT	Tow (dark and coarse)	
W	Waste	

PARTE V

CÓDIGO ADMINISTRATIVO: SECCIÓN III, CAPÍTULO 46, TÍTULO VII, LIBRO II

SECCIÓN III.—*Graduación de fibras*

ARTÍCULO 1771. *Definición de palabras y frases.*—Las palabras y frases usadas en esta sección se tomarán en el sentido que a continuación se indica:

(*a*) "Fibra" se usa con referencia a su significado común y comercial y no en su sentido científico. En esta sección la palabra significa solamente la materia prima y no las fibras parcial o totalmente manufacturadas.

(*b*) "Abacá" significará la fibra de la planta de este nombre conocida técnicamente como *Musa textilis*, y comercialmente como "Manila hemp," "Manila" y "hemp."

(*c*) "Maguey" (cantala) significará la fibra de la planta del mismo nombre, que se conoce técnicamente como *Agave cantala* Roxb., y comercialmente como "maguey," "Manila maguey" y "maguey de Filipinas."

(*d*) "Sisal" significará la fibra de la verdadera planta de sisal, *Agave sisalana* Per., que en la localidad se conoce algunas veces con el nombre de "maguey de Hawaii."

(*e*) "Cordón" significará varias fibras trenzadas a mano para atar haces o madejas.

(*f*) "Bramante" significará una cuerda o un cordón hecho a mano de abacá, maguey o sisal, que ha servido para atar varios haces o madejas.

(*g*) "Estopa" significará los pedazos de fibra rota o fibra fina entretejidos de tal manera que se han roto total o parcialmente durante la operación de cardar en la fábrica.

(*h*) "Desperdicio" significará las fibras rotas o las tiras de fibras limpiadas parcialmente, que han caído debajo de la cuchilla o de la máquina durante la operación de la extracción de la fibra.

ART. 1772. *Normas oficiales para los grados comerciales de las fibras.*—El Director de Agricultura determinará las normas oficiales para los distintos grados comerciales de abacá, maguey y sisal. Cada grado tendrá su designación adecuada y una marca distintiva correspondiente, las que, junto con la base sobre la que se determinan los distintos grados, se definirán por el Director de Agricultura en una orden general. Dicha orden tendrá la aprobación del Jefe del Departamento; y para la diseminación de informes, se facilitarán gratuitamente copias de la misma a los mercados extranjeros, gobernadores provinciales, presidentes municipales y a las demás personas y agencias que las pidieren.

Si en alguna época se cambiare alguna de estas normas, se dará aviso a los mercados locales y extranjeros durante un período de seis meses, por lo menos, antes de que entre en vigor la nueva norma.

ART. 1773. *Normas oficiales para otros fibras determinadas.*—Cuando el estado del comercio de fibras haga conveniente dicho procedimiento, el Director de Agricultura puede, asimismo, fijar los grados normales para el abacá que haya sido limpiado parcialmente o se haya preparado en forma de estopa, desperdicio o cordones. Puede también establecer normas para la fibra de cualquier especie de *Musa* distinta del abacá que tenga demanda en el mercado.

ART. 1774. *Conservación de las normas oficiales.*—Los originales de todas las normas oficiales se prepararán en forma adecuada y se guardarán en seguridad en la Oficina de Agricultura, quedando sujetas a renovación, a discreción del Director de Agricultura, pero sin variación de las normas, según lo exijan las circunstancias.

ART. 1775. *Abastecimiento de normas secundarias para los usos del comercio.*—La división de fibras de la Oficina de Agricultura preparará ejemplares de los diferentes grados de fibras con arreglo a las normas oficiales originales y, después de certificados por el Director de Agricultura, se facilitarán, previa petición, como normas secundarias oficiales, a todos los establecimientos autorizados de graduación, gobiernos provinciales, cámaras de comercio, asociaciones agrícolas y demás instituciones o personas directamente interesadas en la industria, debiendo pagar el verdadero costo de dichas muestras por anticipado la parte que las haya solicitado.

Las normas secundarias preparadas por la Oficina de Agricultura, así como los juegos autorizados, preparados por los establecimientos de graduación y debidamente certificados, se considerará que son normas oficiales para todos los fines.

ART. 1776. *Renovación de las normas secundarias por los establecimientos de graduación.*—Los establecimientos de graduación pueden preparar, exclusivamente para su propio uso, duplicados de las normas oficiales secundarias conservadas por ellos; pero será ilegal para cualquier persona usar dicho duplicado antes de que haya sido aprobado y certificado por el Director de Agricultura o su agente autorizado.

ART. 1777. *Clases de establecimientos de graduación.*—Habrá seis clases de establecimientos de graduación, que se clasificarán (según la cantidad de la fibra suelta que gradúen y enfarden al año) del modo siguiente: Establecimientos de primera clase, los que manipulen cinco mil toneladas métricas o más; de segunda clase, los que manipulen de dos mil quinientas a cinco mil toneladas métricas; de tercera clase, los que manipulen de dos mil a dos mil quinientas toneladas métricas; de cuarta clase, los que manipulen de mil a dos mil toneladas métricas, de quinta clase, los que manipulen de quinientas a mil toneladas métricas, y de sexta clase, los que manipulen menos de quinientas toneladas métricas.

La clasificación de los establecimientos de graduación se basará en la cantidad de fibra graduada y enfardada durante el año anterior al año para el cual se desea el permiso. En caso de un nuevo establecimiento, la clasificación se hará al final del primer año y pagará el derecho correspondiente a dicho año, y el Director de Agricultura puede, a su discreción, exigir una fianza por una cantidad razonable, para garantizar dicho pago.

ART. 1778. *Permisos de graduación.*—Ninguna persona se dedicará a la graduación del abacá, maguey o sisal, a menos que haya obtenido previamente un permiso, el cual estará firmado por el Director de Agricultura. Tales permisos se conocerán por "permisos de graduación."

ART. 1779. *Derechos por permisos de graduación.*—Deberán facilitarse permisos de graduación a cualquier establecimiento de graduación cuyo dueño o dueños justifiquen ante el Director de Agricultura, las condiciones necesarias para llevar a cabo el trabajo, y previo pago anticipado de un derecho anual de mil pesos para los de primera, quinientos pesos para los de segunda, doscientos cincuenta pesos para los de tercera, cien pesos para los de cuarta, cincuenta pesos para los de quinta y veinticinco pesos para los establecimientos de sexta clase.

ART. 1780. *Cobros por graduación y enfardado.*—En lo que sus facilidades se extiendan más alla de las necesidades de su propio negocio, los establecimientos de graduación graduarán y enfardarán fibras para otros dueños, cuando se entreguen en estado adecuado para dicho procedimiento. Ningún establecimiento de graduación cobrará más de ocho pesos por tonelada métrica, por enfardar y graduar cualquier fibra comprendida en esta Ley; pero cualquier gasto incidental al amarre de la fibra en madejas del tamaño correspondiente, o la desecación, si estuviere húmeda, será sufragado por el dueño.

ART. 1781. *Graduación de fibras.*—En la graduación de fibras, cada grado que se prepare deberá corresponder a una de las normas oficiales, y deberá ostentar también la misma designación y marca que ésta. El juego de normas oficiales se colocará en un lugar visible del cobertizo donde se verifica la graduación, para ser consultado.

ART. 1782. *Uso de marcas particulares por los exportadores.*—Todo establecimiento de graduación tendrá derecho a usar una marca o rótulo particular en relación con el nombre de la norma oficial, con tal que dichas marcas se hayan registrado previamente en la Oficina de Agricultura y estén autorizadas por la misma, y con tal, además, que tales marcas se refieran constantemente a la misma norma oficial o a un tipo específico de la misma. Del Director de Agricultura se podrán obtener gratuitamente los modelos de solicitud para el registro de las marcas privadas.

El Director de Agricultura puede, avisando por escrito al establecimiento de graduación, con un mes de anticipación, cancelar el rótulo o los

rótulos de cualquier establecimiento de graduación, una vez probado que dicho rótulo o rótulos no han sido constantes, o si de su uso han resultado equivocaciones o confusiones. La orden de cancelación surtirá efecto inmediatamente, sin perjuicio de la apelación ante el Jefe del Departamento, quien, si decidiere de una manera contraria al Director de Agricultura, ordenará que se conceda de nuevo el rótulo o rótulos cancelados.

ART. 1783. *Enfardado de fibras para la exportación.*—Todas las fibras comprendidas en esta Ley que se destinen a la exportación, se prensarán en fardos que tengan aproximadamente las dimensiones y pesos siguientes: longitud, un metro; anchura, cincuenta centímetros; altura, cincuenta y cinco centímetros; y peso, ciento veinticinco kilogramos, neto.

Cada fardo de fibra estará libre de bramantes, desperdicios, estopa, fibra averiada, fibra no idéntica a la que constituye el fardo, y de cualquier cuerpo extraño, y la fibra deberá estar completamente seca.

Todas las madejas de fibra contenidas en el fardo, serán uniformes en calidad, y cada madeja estará atada con seguridad con un cordón, lo suficiente para sujetar la madeja, y será de calidad idéntica a la de la fibra de que se compone el fardo.

En el abacá de cualquier grado, cuya calidad pueda perjudicarse por exceso de presión, el Director de Agricultura determinará, en una orden general, las dimensiones y peso aproximado de cada fardo de dicha fibra. De igual manera determinará el límite del diámetro de cada madeja contenida en el fardo, la manera en que se han de colocar dichas madejas, y la manera de rotular y atar cada fardo completo.

ART. 1784. *Inspección de la graduación y enfardado de las fibras.*—Los establecimientos de graduación y enfardado de fibras estarán sujetos a la inspección de la Oficina de Agricultura; y será deber del Director de Agricultura disponer un personal adecuado para la inspección y vigilancia de dichos lugares y procedimientos.

El jefe de la división de fibras de la Oficina de Agricultura será el jefe inspector de fibras, y percibirá por ello, además de su sueldo, una remuneración que no debe exceder de dos mil pesos al año.

ART. 1785. *Distribución y deberes de los inspectores de fibras.*—Uno o más inspectores de fibras y el número de auxiliares que sea necesario, se destinarán a cada puerto de exportación y en las estaciones de graduación en que el Director de Agricultura lo estime necesario, a solicitud del interesado o interesados. Será deber de dichos inspectores verificar inspecciones periódicas en todas las estaciones de graduación que se hallen dentro de su jurisdicción; inspeccionar todas las fibras graduadas y enfardadas, comprendidas en esta Ley, que se destinen a la exportación, recaudar todos los derechos de inspección; y expedir a los cargadores o propietarios de la fibra un certificado o certificados que se conocerán por "certificados de inspección," en que se consignará el resultado de su inspección, expresando el número total de fardos inspeccionados por él para cada cargador o dueño, el número de fardos de cada grado y marca (si hay alguna), y todos los demás datos que haya acordado el Director de Agricultura.

ART. 1786. *Nombramiento de inspectores de fibras para la instrucción de los productores.*—El Director de Agricultura destinará, de vez en cuando y según lo permitan las condiciones del servicio, inspectores de fibras para trabajos de instrucción entre los productores de fibras en las Islas. Será deber de dichos inspectores instruir a los productores acerca de la manera en que deben preparar sus productos, de suerte que se ajusten a los

requisitos de esta sección, y proporcionarles los demás informes que les permitan conocer el grado o los grados de las fibras que preparen y los precios corrientes de las mismas.

ART. 1787. *Graduación, enfardado e inspección de las fibras.*—Todas las fibras de las que se hayan establecido normas oficiales como anteriormente se dispone, se graduarán, enfardarán, inspeccionarán, aprobarán y certificarán como se dispone en esta Ley.

ART. 1788. *Requisito general respecto a la graduación y certificación de fibras.*—Ninguna fibra de las comprendidas en esta sección se exportará de las Islas Filipinas, en cantidad mayor de la suficiente para hacer un fardo, sin estar graduada, enfardada, inspeccionada y certificada como se dispone en esta Ley; y con sujeción al mismo límite respecto a la cantidad, ningún establecimiento de graduación embarcará ninguna fibra en ningún lugar de las Islas Filipinas donde esté establecido un inspector de fibras disponible, con destino a cualquier otro puerto de las Islas, sin cumplir con el mismo requisito, excepto mediante permiso por escrito del Director de Agricultura.

ART. 1789. *Aviso que se ha de dar a los inspectores de fibras.*—Los establecimientos de graduación darán aviso al inspector de fibras por escrito, con cuatro días de anticipación, cuando sea posible, del número de fardos dispuestos para la inspección y, cuando sea posible, del nombre del vapor en que estos se embarcarán y del destino del cargamento.

ART. 1790. *Lugar y manera de inspeccionar las fibras.*—Las inspecciones se harán en los cobertizos de graduación regulares, en los que se abrirán por el inspector, para ser examinados completamente, un fardo por cada veinte y los demás que éste considere necesarios. En el caso de recibirse un cargamento de fibra que haya sido graduada y enfardada, pero no inspeccionada, se hará la inspección de cualquiera de dichos cargamentos en el lugar que él designe, y el dueño de dicha fibra facilitará el transporte de los fardos que han de ser inspeccionados al lugar de la inspección y desde el mismo.

Será deber del inspector de fibras determinar si el grado inspeccionado está conforme a la norma oficial para el mismo; si la marca particular usada (si hay alguna) es exacta, y si el enfardado y la rotulación se han hecho de conformidad con la ley y las órdenes o reglamentos legales de la Oficina de Agricultura.

ART. 1791. *Inspección de los locales de los establecimientos de graduación.*—El inspector de fibras u otra persona que actúe bajo su autoridad tendrá libre acceso a los cobertizos de graduación y enfardado, y también a las bodegas donde están almacenados los fardos, de cualquier establecimiento de graduación dentro de su jurisdicción, en las horas laborables para hacer una inspección, con el fin de convencerse de la propiedad de los métodos empleados en ellos. Velará también por que se conserve siempre cuidadosamente, y se renueve en el plazo señalado, el juego aprobado de normas oficiales.

ART. 1792. *Certificación de las fibras inspeccionadas.*—Todo cargamento de abacá, maguey, o sisal, graduado y enfardado, que haya sido inspeccionado y aprobado, irá acompañado de certificado o certificados de inspección, adjuntos al conocimiento de embarque y debidamente firmados por el inspector de fibras que realizó la inspección. Todos los certificados de graduación se extenderán por cuadruplicado, entregándose el original y

una copia al dueño, enviándose otra copia al Director de Agricultura y archivándose en la oficina del inspector otra copia.

ART. 1793. *Transferencia del certificado a nuevo dueño—Expedición de certificado secundario.*—Cuando una partida de fibra que ha sido graduada, enfardada y debidamente inspeccionada y aprobada, fuese transferida, por venta o de otro modo, de un dueño a otro, el certificado de inspección acompañará a la partida, anotándose en él la transferencia de propiedad de la misma por el inspector de fibras de la localidad donde haya tenido lugar la transferencia. Si el comprador desease, no obstante, un nuevo certificado, éste le será expedido por el inspector local de fibras. Este certificado, sin embargo, se conocerá por "certificado secundario de inspección."

ART. 1794. *Segunda inspección de la fibra embarcada en un puerto con destino a otro.*—La fibra que haya sido debidamente inspeccionada, graduada, enfardada y embarcada en un puerto con destino a otro de las Islas Filipinas, no estará sujeta a nueva inspección en el puerto de su destino, excepto previa queja recibida por el inspector jefe de fibras, con tal que no haya estado expuesta durante el tránsito a la humedad o a otra acción que pudiese menoscabar su calidad.

ART. 1795. *Derechos de inspección.*—Por cada fardo de fibras inspeccionado y marcado, el inspector correspondiente cobrará y recaudará diez centavos, ya sea aprobado o rechazado. Dichos derechos se pagarán por el dueño del fardo, a quien se entregará un recibo.

ART. 1796. *Devolución de los derechos de inspección sobre las fibras usadas en manufacturas locales.*—A toda persona que compre fibra graduada, enfardada e inspeccionada para la fabricación de hilaza, mecate o cuerda u otros artículos, se le devolverán los derechos de inspección mencionados y dispuestos en la presente, mediante presentación al Director de Agricultura del certificado de inspección que abarque el número de fardos consumidos en dicha industria, además de una declaración jurada de que dicho número de fardos se ha consumido realmente en dicha industria dentro de las Islas.

PARTE VI

CASTIGO

Código Administrativo: Sección XV, Capítulo 66, Título XII, libro IV

ART. 2748. *Infracción de las disposiciones relativas a la graduación de fibras.*—Toda persona que cambiare, borrare o falseare, en todo o en parte, o hiciera que se cambiare, borrare o falseare, la marca o distintivo oficial o particular en algún fardo de fibra que haya sido inspeccionado, graduado y estampado como se dispone en los artículos mil setecientos setenta y uno a mil setecientos noventa y seis, inclusive, de este Código, o que usare algún marbete o marca que no estuviere de conformidad con las disposiciones de dicha sección o de las órdenes autorizadas del Director de Agricultura, o que se entrometiere o alterare la cantidad o calidad de cualquier fardo de fibra que haya sido inspeccionado, graduado y sellado de este modo, o que de otro modo infringiere alguna de las disposiciones de dichos artículos, será castigada con una multa que no exceda de trescientos pesos; y una vez convicta una persona que posea un permiso de graduación en virtud del presente, el Director de Agricultura puede, con la aprobación del Secretario de Instrucción Pública, retirar y cancelar dicho permiso.

196418——7

PARTE VII

ORDEN EJECUTIVA No. 60

[Creando la Junta Consultiva de Fibras]

MANILA, *26 de Octubre de 1922*

ORDEN EJECUTIVA No. 60

Por la presente se crea una junta, que se denominará Junta Consultiva de Fibras y se compondrá del Jefe de la División de Fibras de la Oficina de Agricultura, o su representante, como presidente, y cuatro vocales, que servirán sin percibir remuneración y serán nombrados, de vez en cuando, por el Director de Agricultura, con la aprobación del Secretario de Agricultura y Recursos Naturales, de entre los productores, comerciantes y exportadores de fibras de Filipinas, con el objeto de consultar con el Director de Agricultura en la solución de las cuestiones que se susciten en la clasificación, graduación y embalaje de las fibras de Filipinas, según se prescribe en la Ley Número Dos mil trescientos ochenta.

Por la presente se ordena al Director de Agricultura que enmiende, con la aprobación del Secretario de Agricultura y Recursos Naturales, la Orden General Número Cincuenta y cuatro de la Oficina de Agricultura, de manera que contenga disposiciones relativas a la creación y funciones de la mencionada junta y que rijan el nombramiento de los vocales de la misma.

(Fdo.) LEONARD WOOD
Gobernador General

PARTE VIII

ORDEN ADMINISTRATIVA No. 23

Reglamentos sobre el nombramiento de los miembros de la Junta Consultiva de Fibras y los métodos bajo los cuales dicha junta funcionará

MANILA, *Noviembre 13, 1922*

ORDEN ADMINISTRATIVA No. 23

En cumplimiento de las disposiciones de la Orden Ejecutiva No. 60, fechada el 26 de Octubre de 1922, se promulga el siguiente reglamento que regirá sobre el nombramiento de la Junta Consultiva de Fibras y los métodos bajo los cuales la misma funcionará:

Reglamento que regirá sobre el nombramiento de los miembros de la Junta Consultiva de Fibras y los métodos bajo los cuales dicha Junta funcionará:

ARTÍCULO 1. El Director de Agricultura, con la aprobación del Secretario de Agricultura y Recursos Naturales, nombrará cuatro miembros e igual número de suplentes de entre los productores, comerciantes y exportadores de fibras; *Entendiéndose,* Que será nombrado sólo un miembro de cada asociación, firma comercial, compañía o corporación localizada en el mismo puerto de exportación.

ART. 2. Será deber de la Junta cuando se la solicite emitir después de una detenida deliberación su opinión sobre todas las cuestiones que se

sometan a su consideración, tales como las que provienen de una clasificación o graduación controvertida de fibras.

ART. 3. Cualquier parte interesada podrá pedir al Director de Agricultura que se someta cualquier punto en controversia sobre clasificación o graduación de fibras en que la misma esté interesada a la Junta para su estudio y decisión.

ART. 4. La Junta determinará en cada caso la parte que deberá pagar los gastos incurridos en reclasificar y reenfardar todos los fardos abiertos por la Junta Consultiva de Fibras como muestras.

ART. 5. En caso de que un lote de fibras comprado o vendido por una persona que es miembro de la Junta Consultiva, o por una compañía o firma que tiene un miembro en la referida Junta, dicho miembro de la Junta no tomará parte en la deliberación de la cuestión en que dicha persona, compañía o firma está interesada. En tales casos el Director de Agricultura nombrará el número necesario de suplentes para llenar los puestos de los miembros así afectados en la discusión del asunto envuelto, y para completar el número requerido de miembros de la Junta.

ART. 6. Los miembros de la Junta Consultiva de Fibras servirán como tales sin compensación alguna por el período de un año, contado a partir de la fecha de su nombramiento, y no podrán ser nombrados de nuevo dentro de seis meses después de la expiración de su cargo.

ART. 7. En caso de alguna controversia que requiera la intervención de la Junta, la parte interesada notificará por escrito sobre la misma al Director de Agricultura, por lo menos, con 24 horas de anticipación, haciendo constar en la notificación el número de fardos de cada grado en el lote que se ha de reinspeccionar y el lugar en el puerto de exportación donde los fardos se encuentran.

(Fdo.) ADN. HERNÁNDEZ
Director de Agricultura

Aprobada:

(Fdo.) RAFAEL CORPUS
Secretario de Agricultura
y Recursos Naturales

The Philippine
Agricultural Review

VOL. XVI THIRD QUARTER, 1923 No. 3

A QUARTERLY PUBLICATION

ISSUED IN ENGLISH BY THE
BUREAU OF AGRICULTURE

The Government of the Philippine Islands
Department of Agriculture and Natural Resources

Subscription rates: ₱2 (Philippine currency) or $1 (U. S. currency) per annum in the Philippine Islands and the United States and territories.
$2 (U. S. currency) per annum in foreign countries

MANILA
BUREAU OF PRINTING
1923

(Entered at the Post Office at Manila as second-class matter)

ERRATUM

Twenty-Second Annual Report of the Bureau of Agriculture

Page 115, line 19, sulphuric acid (H_2SO_4) should read cyanide gas.

THE PHILIPPINE

Agricultural Review

VOL. XVI THIRD QUARTER, 1923 No. 3

TABLE OF CONTENTS

Page

1. President's Annual Address (Philippine Veterinary Medical Association), by Harry F. Kern, D.V.M. 157
2. What is the Cause of Osteoporosis? by Louis P. Koster, D.V.M. 162
3. The Anthrax Outbreak at Canlubang, by Segundo Alano, D.V.M. 169
4. Tobacco Growing in Cuba, by Domingo B. Paguirigan 174
5. Experimental Milling Tests of Adlay, by James F. Hayes 197
6. Experimental Baking Tests of Flour Made of Adlay, by Walter K. Marshall 201
7. Demonstration Showing the Baking Qualities of Adlay Flour in Batters and Doughs other than Yeast Bread, by Minna C. Denton and Elsbeth Hoffman 205
8. Additional Notes on Adlay, by P. J. Wester 212
9. California Scaly Bark and Bark Rot of Citrus Fruits in the Philippines, by H. Atherton Lee 219

ILLUSTRATIONS

Facing page—

PLATE. I. Aspect of a shade-grown field just after priming ... 176
II. Picking seedlings that are ready to be transplanted ... 178
III. (a) Furrow fertilizing ... 180
(b) Fixing fertilizers in the furrows with an ordinary field cultivator ... 180
IV. Cuban prevailing methods of transplanting ... 182
V. Panoramic view of extensive tobacco fields covered with cheese-cloth ... 184
VI. Partial shading with royal palm leaves is used successfully as a substitute of the cheese-cloth ... 186
VII. Aspect of a shade-grown field at the time of the third priming and methods of handling harvested leaves ... 188
VIII. Time for topping ... 190
IX. Exclusive wrappers are strung back and face to face at the rate of 36 leaves to a pole. Notice the cheese-cloth shading to the right ... 192
X. (a) A "Veguero" or tobacco farmer at home ... 194
(b) The "mancuernas" are made to ride on poles and exposed in the sun during the rest of the day ... 194
XI. A typical Cuban tobacco curing barn ... 196
XII. Heads of one of the best forms of adlay from Bukidnon, Mindanao ... 198
XII. (a) Experimental receiving separator ... 198
(b) Experimental scourer ... 198
XIV. Experimental mill ... 200
XV. (a) Receiving separator ... 200
(b) Double runner attrition mill ... 200
XVI. (a) Admixture of adlay flour and hard wheat flour ... 202
(b) Admixture of adlay flour, commercial hard wheat flour, and durum (Macaroni) wheat flour (Graham) ... 202
XVII. Loaf at the Left—Admixture of commercial blended flour; loaf in the middle-admixture of adlay flour and commercial hard wheat flour; and loaf at the Right—admixture of adlay flour and commercial hard wheat flour ... 204
XVIII. Loaf "A;" loaf "B;" and loaf "C" ... 204
XIX. The lesions of California scaly bark on sweet orange, *Citrus sinensis*, about natural size ... 220
XX. A view of the lesions of scaly bark on sweet orange, *C. sinensis*, after the overhanging bark has been removed, showing the whorls of erupting tissue; about natural size ... 220
XXI. (a) Cut through an area of affected tissue, showing young active tissues pushing through the outer bark; about natural size.
(b) The erupting tissues shown in the preceding figures are shown here after being dissected out; their origin and type of outgrowth is shown here, about natural size ... 220
XXII. White ooze, the most obvious symptom of bark rot ... 222
XXIII. Old lesions of bark rot on tree of mandarin orange ... 224
XXIV. (a) A trunk of sweet orange tree affected with California scaly bark ... 224
(b) A trunk of mandarin orange tree affected with bark rot ... 224
XXV. A limb of a mandarin orange tree, entirely girdled and killed by bark rot ... 226
XXVI. A sweet orange tree killed by psorosis or California scaly bark in the Philippines ... 226

TEXT FIGURES

FIG. 1. A rough sketch of Cuba showing tobacco zones ... 176
2. Flow sheet of experimental mill ... 198

PRESIDENT'S ANNUAL ADDRESS [1] (PHILIPPINE VETERINARY MEDICAL ASSOCIATION)

By Dr. HARRY F. KERN, *Bureau of Agriculture*

Again we have met under the name of the Philippine Veterinary Medical Association for the consideration and discussion of subjects which appertain to veterinary science. This association was first organized some sixteen years ago by the veterinarians in the Philippine Islands for the purpose of promoting and elevating the veterinary profession. Similar organizations throughout the world have been the principal means of bringing the members of the profession together so they might benefit from each other's experiences. These organizations have not only assisted the individual but have also raised the standard of the veterinary profession until it is now recognized among the learned sciences of the world.

But veterinary science, besides being one of the youngest, is perplexing because in treating animals for diseases we undertake to analyze with our intellect the sufferings of dumb brutes that can neither talk, read nor write. The veterinarian of today is not the one of fifty years ago, or even twenty, when the village blacksmith not only shod the horse but treated its ailments as well. Each year finds the profession nearer and nearer the goal of perfection, but there is still a long way to travel before it can be reached, for no longer is the practice of the veterinarian confined to the treating of disease alone. He must be able to advise his client how to improve his animals along sound breeding lines as well as to their proper care.

The past year in veterinary science in the Philippine Islands has been an eventful one, yet we can hardly claim it has been one of the most constructive. The same persistent diseases, rinderpest, anthrax, surra, and foot-and-mouth disease still continue to take the heaviest death toll in the livestock industry. During the past year occurred the worst outbreak of anthrax in the Philippines, at least since American occupation. In the same

[1] Delivered at the Eleventh Annual Meeting of the Philippine Veterinary Medical Association, Rizal Hall, University of the Philippines, Manila, February 12, 1923.

territory where the cattle and carabaos were dying from anthrax, rinderpest was also serious. About the middle of the year some unknown disease appeared and killed a number of horses in the City of Manila. From the investigation made there is reason to believe the deaths were due to forage poisoning from feeding contaminated Barit grass. Hog cholera has been quite prevalent in several localities and has caused considerable loss in the hog industry. From nearly all the larger islands in the Philippine archipelago come reports of animals dying from various diseases. Veterinary work is only beginning in the Philippine Islands and there still remains a colosal task along scientific and practical lines.

It has been possible for the College of Veterinary Science to carry on some experimental work during the past year or two, but there is much research work which should be carried on with animal diseases and only by continuing this work with the greatest interest and consistency can we expect to arrive at definite means for controlling them. More and more are we looking towards the prevention of diseases and less and less towards the treatment.

In past years we have been too optimistic in thinking we could entirely eradicate the contagious and infectious diseases from the Islands. Once a disease is spread and well established in a country it becomes endemic and practically impossible to eradicate, but may be controlled. Progress has been made in controlling the contagious diseases, but so far as their entire eradication is concerned this is a remote possibility.

The Bureau of Agriculture has for several years given practically all its time and attention to the control of rinderpest. From this disease there seems to be no permanent relief and it is necessary to keep a large force of men in the field to partly check it. With all the work that has been done on rinderpest for years, we are just beginning to learn how little we really know of its transmission. Quarantines, vaccines, serums, simultaneous immunization, all have been used to combat this disease and yet it is not conquered. This does not mean that all are a failure so far as results are concerned. Some of these have given exceptional good results, but are not practical because they are not popular with the people. First, there must be the proper means for controlling diseases whether it is by quarantines or biological products and, secondly, there must be a willingness on the part of the people to use the treatment. But that a certain method of disease control does not give ab-

solute results or it is not popular is no reason that it should be given up in disgust. Science will win in the end.

In some parts of the Islands, especially in Mindanao, we find some of the large cattle raisers undertaking to raise cattle which are at least partly immune to rinderpest. This is seemingly sound reasoning and warrants consideration from an economic viewpoint. The Indian cattle being highly resistant to rinderpest, owing to their having been raised in rinderpest infected territory and subjected to infection, have a tendency when crossed with the native cattle to transmit this resistance to their offspring. Aside from this advantage the crosses are usually of much larger size than the native. But should the Indian cattle be raised in non-infected rinderpest territory for two or three generations it is very probable they would lose this resistance and be unable to transmit any immunity to their offspring. Furthermore, whatever improvement the Indian crosses may be over the native this only affects the cattle industry of the Islands. There is still the question of the carabao, which is even more susceptible to rinderpest than cattle are. The carabao is the poor man's beast of burden and its protection should be a prime consideration.

The greatest drawback to the Indian crosses are the difficulties encountered in raising them under range conditions. Great care must be taken in handling these animals, for if not, they soon become unmanageable. The meat of the Indian cattle is somewhat coarse and not of so good a quality as the native. In India this is of no importance since these cattle are not used for food purposes.

There is a great necessity for a closer union between animal husbandry and veterinary science. The prevalence of so many contagious diseases in the Philippines makes it impossible for the one to be separated from the other if results are to be expected. So long as the people continue to raise scrubby animals, so long as food and work animals are imported from foreign countries because they are superior to the native, so long will the field for veterinary practice be confined to its present narrow limits. Outside two or three of the large towns there is no field for veterinary practice to be found in the Philippine Islands.

To improve the native animals there is need for a castrating law in order that the scrub animal may be eliminated. There is also need of legislation which will grant the owners of good male animals a yearly gratuity. A small gratuity for keeping

a good animal, it is believed, would induce people to keep their best males for breeding instead of disposing of them. Usually the best of the males are sold, because they bring a better price, and the scrubs kept for breeding. Much can be done to improve the native animals without importing foreign animals, and it costs just as much to raise a scrub as a good animal.

More knowledge is gained along practical lines from actually doing and seeing than from reading out books. Not until the livestock raiser comes in contact with good animals does he realize the importance of improving his herd. Livestock shows have in the past done more to bring this condition about than any other one thing. The livestock show has been badly neglected in the Philippine Islands. This year's Carnival, which advertised as the greatest Industrial Exposition ever held in the Philippine Islands, had not one agricultural animal on exhibition. Let us hope that in the future more consideration will be given to the livestock industry at carnivals, fairs, etc.

With the advent of improved livestock will come the opening and need for the services of the veterinarian. Aside from the field for veterinary practice there are excellent opportunities for raising livestock, which should be more profitable than practicing the profession. With some knowledge of animal diseases, the veterinarian is well prepared to enter this field. We cannot expect the livestock raiser to call for a veterinarian to care for his animals which it has cost him nothing to raise, and neither can one expect people to raise better animals until there is a better inducement to do so.

During past year a law became effective which prohibits the importation of cattle on the hoof from foreign countries for human consumption. It is doubtful if this law can long stand the test, owing to the increased demand which will naturally be made on the local supply of cattle. Should the price of native cattle rise to any extent it will probably result in the cattle raisers selling about all the females, and this in time will paralyze the cattle industry. The raiser of unimproved cattle is receiving a fair price for his livestock and now should the price go higher there will be little or no inducement to raise better animals.

Last year saw the closing of the simultaneous immunization stations for the immunization of native cattle and carabaos against rinderpest, which was a mistake in many prospects. This method for controlling rinderpest had had its ups and downs for several years, but had reached the point where its

value as a protection against this dreaded disease was no longer doubtful. Some may challenge this statement on the grounds that the simultaneous method is expensive and sometimes unpopular with the owners of animals, owing to the length of time it takes to complete the treatment. We cannot get something of value for nothing, and neither is it possible to satisfy everybody. These stations were not closed because results were not obtained, but because politics entered in, and politics many times have a tendency to be destructive rather than constructive. There is nothing that has given the veterinarian more satisfaction in his work than to see animals immunized by this method remain free from rinderpest when placed in the same pasture with sick animals.

More and more are biological products coming into use for the treatment of diseases of animals. In dealing with contagious and infectious diseases much depends upon the proper preventive measures, which include particularly such biological products as vaccines, serums, and bacterines. It is very apparent that in the future there will be a larger sale for these in the Philippines. At the present time most of the biological products are used by the Government, or at least in connection with it, for various reasons. The more the field for the use of these products enlarges the more commercialized they will become. It seems probable that we are approaching a time when at least a part of the control of animal diseases can be placed in the hands of the private practitioner under the supervision of the central Government.

In using biological products the greatest care should be taken not to claim for them something that it is reasonably sure they will not accomplish. It is much better to fully inform the client at the start of the results to be expected from these products than undertake to explain afterwards should dissatisfaction arise.

On the animal industry of the country depends the life of the veterinary profession and on the prosperity of this industry depends the control of the disease and the improvement of breeding. The Philippine Islands is in a much better position than some of the other countries which have been ravaged by war, to carry out comprehensive research work to solve the problems of improving the animal industry. The responsibility of the veterinarian in these Islands are great and we must not abandon our duties, but strive to build up the profession which is an economic factor in the country's agriculture.

WHAT IS THE CAUSE OF OSTEOPOROSIS?[1]

By LOUIS P. KOSTER, D.V.M., *College of Veterinary Science*

The frequency with which cases of osteoporosis have been met with in the clinic of the College of Veterinary Science at Los Baños, Laguna, during the past two years is most striking and if it may be regarded as indicative of the incidence of the disease throughout the Islands, the effect upon livestock interests must be considerable. Although the only important pathological lesions found have been confined to the bones, the disease has always been more or less associated with a supposed faulty nutrition or assimilation. These two considerations and the widespread attention which the so-called deficiency diseases are attracting at the present time leads to my selection of that topic as the subject of this paper, rather than the fact I have any original observations to present or theories to advance.

The term osteoporosis, in a restricted sense, refers to a pathological condition of the bones wherein they become enlarged, softened, and porous through absorption of the calcareous or compact substance. Without entering into a description of the histology and pathology involved, it is sufficient to say that the alterations are the result of a diffuse rarefying ostitis with its attendant phenomena. The term, as here employed, has a broader significance and refers particularly to a disease of equines characterized by a gradual and progressive development of these changes in the bones, which application of the term in a manner embraces and amplifies its narrower meaning. Because of the fact that the same alterations occur in the osseous structures of other animals affected with osteomalacia and constitute likewise the most conspicuous symptom of that disease many writers, especially Europeans, have recognized no distinction between the two conditions and regard them as identical. While there is justification for the view on the ground of pathological findings, there are several reasons why it is unacceptable when inquiry is made into the etiology and it is greatly at variance with many clinical observations. In consequense .of

[1] Presented in the Eleventh Annual Meeting of the Philippine Veterinary Medical Association, February 12, 1923.

this difference of opinion much of the literature on the subject is confusing.

Osteomalacia usually occurs under certain well-defined conditions and can generally be attributed to a definite cause easily demonstrated. Equine osteomalacia, or osteoporosis, on the other hand, occurs under a great variety of circumstances and the cause is rarely apparent but on the contrary is usually vague and obscure. However, the belief that the disease in horses cannot be ascribed in all cases to the same cause that is responsible for the disease in other animals has undoubtedly the greater number of adherents. As a result many theories have been advanced by the latter class to account for its occurrence, but none is entirely satisfactory. While some are quite plausible they fall for lack of evidence; others are obviously erroneous. The chief of these theories, the bases on which they are evolved, and the arguments for and against them may be enumerated as follows:

(1) *Deficiency of mineral content in the diet and water.*—This explanation receives its principal support from the established fact that the same factor operates as a cause in the development of osteomalacia. While it is conceded that calcium and phosphates are necessary to form bone it is rare that any food does not contain even an excess of these elements and it must be remembered that osteomalacia is more common in cattle, particularly in those which are pregnant or yielding large quantities of milk. In both these conditions the loss of mineral salts to the body is unusually heavy so that the deficiency in the diet must be regarded to a large extent as relative and the amount present sufficient for all ordinary requirements, that is, when heavy lactation or pregnancy is not present. The apparent infrequency of the condition in the horses of Europe in those countries where osteomalacia is prevalent in cattle would tend to confirm the correctness of the observation. However, it has been shown by chemical analysis that an actual deficiency in the food or water does exist in some cases. As the horse normally excretes larger amounts of mineral salts than other animals, particularly in the urine, and as there is no appreciable diminution in this regard when osteoporosis is present, it may be that the few cases occurring in the horses of the continent are due to faulty composition of their diet and that the causative agent operating elsewhere is not present.

One reason why this assumption cannot be accepted as the cause of osteoporosis in a large majority of cases is the prompt-

ness with which cattle affected with osteomalacia generally respond to appropriate treatment in the form of a corrected diet and the administration of the lacking mineral salts. Under the same conditions it is but natural to expect that the same measures would prove equally efficacious in the treatment of osteoporosis of horses were that affection the result of a similar cause. Such, however, is not the case and the treatment of horses, with few exceptions, is generally unsatisfactory. Another inconsistency of the theory is to be found in the isolated cases of osteoporosis which occur in large stables where all the inmates receive an identical ration. In these cases the question naturally arises, "if the feed and water are at fault why shouldn't all be affected?"

Regarding water, it is the one thing, exclusive of the air, which all animals in a community have in common and the generally sporadic character of the disease would appear to dismiss a deficiency of inorganic salts as a causative factor. Even though such were the case, it is well known that only a small amount of the solids taken up by the body are derived from the water ingested; the principal dependence for minerals being placed upon the absorption of complex chemical compounds from organic foods.

As a final comment on this theory it seems reasonably safe to say that a deficiency in the mineral content of the feed and water cannot be seriously regarded as a primary cause of osteoporosis in horses in the great majority of cases, although it may be a contributory factor. Its rôle in the production of osteomalacia is undoubtedly important but there appears to be little ground afforded for drawing an analogy as to cause between the two conditions on this basis alone.

(2) *Defective absorption of calcium.*—According to this theory the mineral content of the diet is accepted as satisfactory and the process of absorption is accused of inability or failure to take up and convey the requisite amount of calcium from the digestive tract to the tissues. After the administration of calcium salts to an animal practically all of the amount ingested can be recovered in a short time in the excretions which would tend to show that absorption of the substance is very little even under normal conditions. Of course, it may be necessary for the calcium to be in organic combination for active absorption to occur. But in plants it exists in this state and generally in large amounts. The presumption seems reasonable notwithstanding these facts and although it meets with

strong refutation in the analyses of the blood of affected horses. That fluid shows little or no alteration in calcium content from blood obtained from individuals in a normal state of health.

(3) *Acidosis.*—In this case the blood is incriminated. Lactic or carbonic acid is supposed to accumulate in the circulation and to counteract the acidity, mineral salts are withdrawn from other tissues to accomplish neutralization. Persistence of the condition is believed to result in decalcification of the bones. The theory does not appear to merit much consideration and even its acceptance would throw very little light on the subject. The chief objections are that the blood is never acid in reaction and experimental injections of lactic acid fail to produce osteoporosis.

(4) *Infection.*—The suggestions that the disease is infectious finds many exponents although no causative organism has been isolated and the investigations so far conducted have proved inconclusive. Much clinical evidence, however, can be so construed as to point in this direction and further work along this line may reveal an etiological agent which has escaped detection so far by reason of its ultra-microscopic nature. It has been asserted by Petrone that pure cultures of *Microcaccus nitrificans* injected into dogs produce nitric acid which dissolves the calcareous tissues and that a disease simulating osteomalacia can be produced. Later experiments failed to confirm this; only negative results being obtained. Another investigator, Morpurgos, working with white rats isolated gram positive *diplococci,* cultures of which, on subcutaneous injection, produced, in healthy rats, symptoms of typical osteomalacia or rachitis, according to the age of the animal. The period of incubation was quite variable, ranging from eight days to three months. In another series of experiments conducted by Moussu, the bone marrow of a pig in the initial stage of the disease produced by subcutaneous inoculation a similar affection in previously healthy pigs, goats, and rabbits.

The infection theory receive additional support from the illustrations afforded by the many stables in which a case of osteoporosis is practically always present in a more or less advanced stage. These examples are not as numerous now as formerly; they were common in the days when the livery-stable flourished. In those days there were stables in which affected horses were being constantly removed while there were others, as now, in which the disease never appeared. There were stables, to my personal knowledge, in which one particular stall

seemed to be infected and every animal which occupied it sooner or later contracted the ailment. Other stalls in the same stable were apparently entirely innocous. Almost invariably tearing out the stall-partitions with the fittings, together with disinfection of the area, was followed by a disappearance of the trouble. Many such stalls were simply left unoccupied for years through fear of a repetition of former experience and were often designated as "the big-head stall."

On the other hand numerous experiments have been conducted by inoculating a normal horse with the blood of an affected horse and always without result. A piece of the diseased lower jaw of a colt has been transplanted into a cavity prepared for its reception in the jaw of a normal horse but without producing the disease. Sir Arnold Theiler in reporting his failure to transmit the disease by blood-inoculation in South Africa, suggests an intermediary host, probably an insect, as the medium of dissemination. He points to the case of East African Coast Fever, in this connection, which disease is easily conveyed by ticks, although like osteoporosis, it cannot be reproduced by blood inoculations.

To sum up the infection theory, probably more substantial evidence can be brought forward to its support than in the case of any of the other theories in spite of the fact that no specific organism has been isolated and that the disease cannot be reproduced experimentally.

(5) *Toxemia.*—It has been considered by some that nearly all of the so-called cases of rheumatism in the horse are really osteoporosis and that the disease has its beginning in a muscular inflammation which later extends to the bones. The theory presupposes the existence of an irritant of unknown origin, probably a toxin, in the tissues, which induces a hyperemia of the bone. It has been demonstrated that a prolonged condition of this sort will result in changes similar to chronic inflammation in the areas of bone-formation and that a proliferation of cartilage and bone will ensue without a corresponding increase in lime salts necessary for complete calcification. Certainly, it is difficult to differentiate clinically between the early stages of osteoporosis, when no visible enlargement of the bones is present, and rheumatism. Whether either disease, or both, are due to toxemia is still an open question.

(6) *Lack of fact and soluble vitamin.*—Chemical analysis of osteoporitic bone, when compared with that of normal bone shows a reduction in the amount of fat as well as a decrease

in the inorganic constituents. This fat, long ago, suggested the possibility that a deficiency of fat in the ration might be an etiological factor, but the implication has never received much attention. However, recent experiments conducted on dogs, with the object of studying the effects of different diets upon the production of rickets, appear to show that the fat-soluble vitamin plays a very important rôle in that disease, although the work cannot be regarded as conclusive as yet. While there are some points of difference between the two diseases of rachitis and osteoporosis, it would seem that enough similarity exists to warrant some investigation in this direction. Of course, normally herbivorous animals do not ingest as much fat with their ration as to the carnivora. The principal source of that substance in the nutrition of the former class of animals is derived from the conversion of the carbohydrates in which their diet abounds.

(7) *Disturbance of the ductless glands.*—The basis of the theory is the hypothesis that the increased activity of certain ductless glands has a causal relation to osteoporosis. The production of an osteoporotic condition in rabbits by the feeding of normal thyroid substance and the enlargement of the thyroid gland which is occasionally seen animals affected with the disease has led some to regard the condition as a form of hyperthyroidism. Others incline to the belief that hypersecretion of of the ovaries leads reflexly to hyperemia and later to softening of the bones. This view rests entirely on the favorable results which sometimes follow ovariectomy in women affected with osteomalacia. In animals, however, neither partial extirpation of the thyroid gland or castration has any marked effect in influencing the course of the disease and unsexed animals do not appear to be less susceptible to contracting it.

(8) *Hygienic surroundings and climatic conditions.*—The sanitary features of animal habitations have no direct connection with the occurrence of osteoporosis as reported by some. The disease is encountered both in horses kept under the most hygienic as well as under the worst possible sanitary arrangements.

The contention that climatic conditions have a bearing upon the occurrence of the disease, possibly thru the agency of bacteria, is given some weight by observations made in Hawaii. It was noted that in localities visited by a heavy annual rainfall the disease was extremely common while in those in which the rainfall was comparatively light the malady was practically

unknown. Furthermore, removal of the affected animals from the wet to the dry districts was followed by improvement and frequently by recovery.

It is evident from the foregoing considerations that much intensive study and investigation will be necessary before a solution to this perplexing problem is reached. The disease is a constant drain on the horse strength of the country and does not receive the attention which its importance deserves because of its insidious and non-spectacular nature. It should prove one of the most attractive and absorbing subjects of research in the veterinary field and it is to be hoped that further work in this direction will be carried on.

THE ANTHRAX OUTBREAK AT CANLUBANG, LAGUNA

By SEGUNDO ALANO, D.V.M.

The most virulent, the most destructive anthrax outbreak in the Philippines recorded so far, was the outbreak in Laguna Province in 1922, which started in the vicinity of Canlubang, Calamba.

The first appearance of anthrax at Canlubang during the year 1922 occurred about the end of March, as near as can be learned from the investigation made by Dr. H. F. Kern and the writer, both of the Bureau of Agriculture. The barrio of Canlubang, which is in the municipality of Calamba, comprises principally land owned and cultivated by the Calamba Sugar Estate, for the production of sugar cane. A part of the land is rented to various planters who farm the land on a crop percentage basis, furnishing their own animals to do the cultivation.

Anthrax first appeared at a time when the Sugar Estate was opening up some new land which was covered with shrubs and small trees. A planter on the estate, a certain Mr. Navarro, was using his animals to cultivate a part of the new land. One evening after they had finished their day's work one of the carabaos suddenly fell dead. The death was reported to the livestock inspector of the estate who attributed it to overwork. This appeared plausible since it was at a time of the year when the work animals were hard worked. During the same week two more of the carabaos in the same herd died under the same circumstances, and again the deaths were laid to overwork. All three of these animals died suddenly and without showing any symptoms of any disease previous to death.

For over two weeks no more death was reported from this locality, but on April 26 an old carabao suddenly died in the Pitland pasture which belongs to the Sugar Estate. This pasture was about four kilometers from the lot of Navarro. A small stream running through Navarro's flows down through the Pitland pasture. A part of this pasture was used as a detention corral for the recuperation of work animals, and the other, for raising chickens and hogs.

At the time Navarro lost three of his carabaos there were nine carabaos and eight work bulls in the Pitland pasture which had come from various parts of the estate. These seventeen animals were confined to about two hectares of pasture, and had been there for nine days when the first one died on April 26. Shortly after, one more carabao died; another became sick and was sent to the hospital for treatment, but died before any medicine could be administered. The temperature of this animal was reported normal and, aside from a staggering gait, there appeared to be nothing wrong. Post mortems were held on both animals and several pieces of gravel were found in the rumen of each. The internal organs were apparently normal, so the cause of death was thought to be due to emaciation. owing to the scanty amount of feed in the pasture.

On the afternoon of April 29, four more of the carabaos in the same pasture were reported dead. From the information of the caretaker, the animals were eating in the morning, lay down about noon, and died at about two in the afternoon. Two of the animals were autopsied, but nothing abnormal was found. The flesh of these two animals were thoroughly cooked until it could be separated from the bones and was fed to the hogs in the pasture.

In the Pitland pasture there were two herds of pigs. The big herd was situated in the upper part of the pasture away from where the carabaos and cattle were, and was separated from them by a wire fence. The other herd which consisted of about one hundred pigs was located in the lower part of the Pitland pasture where the carabaos and cattle were. Unfortunately the caretaker, not following the order strictly, gave some of the raw meats to some of the pigs in the two herds; and the pigs began to die in about six days.

In the mean time two more of the carabaos died and were autopsied by Dr. W. H. Boynton and Dr. I. Patdu (both of the Research Laboratory). No changes were found to have taken place in the internal organs and it was again suspected that the animals had died from starvation.

Considerable interest was taken in the cause of death of these animals since some of them had recently been vaccinated against rinderpest. It was soon learned, however, that these deaths had no connection with the vaccine work.

On May 11 Dr. Boynton, Dr. Kern, and the writer went to Canlubang and autopsied a sow which had been fed with raw carabao meat showing symptoms of inflammation around the

throat; and another work bull which had swelling on the legs. Both of these animals were slaughtered and blood and tissues were obtained from their various internal organs. Slides and culture made from both the hog and from the old work bull revealed nothing. By this time the disease was running a slower course and several of the animals developed edematus swellings on the different parts of the body, sometimes around the throat, on the root of the neck, on the shoulder, on the flank and sometimes on the legs.

The disease continued to spread and the number of deaths increased daily. The possibility of poisoning from the Daris plant was carefully investigated, and the grass in the pasture was carefully examined since this plant is known to grow in the territory near Canlubang, but no trace of this plant could be found, so poisoning was eliminated as a possible cause of the deaths. That the disease was contagious, there seemed to be no doubt yet all inoculations so far had proved negative. Guinea pigs and rabbits were taken from Manila to conduct farther inoculation tests. One of the rabbits was inoculated with oedematous fluid and blood from a swelling on a bull, and the other with blood from the heart of a carabao which had been dead for about five hours. The guinea pigs were inoculated with blood and oedematous fluids from affected work bulls. The rabbit inoculated with the heart's blood of the carabao died in about forty-eight hours, but the other rabbit and two Guinea pigs remained healthy. From the heart of the rabbit which died, Doctor Boynton was able to isolate an organism in filaments with square ends which resembled the organism of anthrax. Owing to the few organisms which were visible under the microscope and in view of the fact that putrefaction was well advanced in the carabao when the rabbit was inoculated, it was considered avisable not to make any conclusion. It was next undertaken to transmit the disease by inoculating cattle. Three cattle were inoculated with blood from affected animals and isolated near the mill of the Sugar Estate. These animals were inoculated with both blood and edematous fluids from the swellings of sick animals. The temperature of these animals were taken daily but there was not the least rise nor did any other symptoms develop.

The disease took at least two distinct forms, those with symptoms and those without symptoms. At the beginning the majority of the affected animals died suddenly without develop-

ing any visible symptoms, but later on the edematous swellings develop more and more. Those in which the symptoms were present ran a slower course. The first thing that was noticed, was the rise of temperature which was followed the next day by the appearance of circumscribed edematous swellings in different parts of the body—sometimes on the throat, on the side and root of the neck, on the shoulder, on the dewlap, on the flanks, on the abdomen, and on the legs. The eyes were clear and urine and fæces were normal. The animal did not lose its appetite and continued eating during the course of the disease. In the case of those in which these symptoms were absent, blood sometimes oozed from the teats and pores of the abdominal skin, and from the sexual organs after death.

We seldom had an opportunity to obtain specimens or make inoculation from any of the sick animals except those on which swellings developed. Either these animals were buried or they had been dead for several hours and putrefaction had taken place when we reached them.

It was not until one morning about the first of June when an autopsy was held on three work bulls which had died during the night, that definite diagnosis of anthrax was made. These three animals were the property of the Calamba Sugar Estate, and had died in a corral where there were several other cattle and carabaos. The animals had just been hauled from the corral, where they died, and the men were already digging the graves for their burial when we arrived.

An autopsy was immediately made, and typical lesions of anthrax found. The spleens of all three animals were three times their normal sizes, and of the consistency of blackberry jam. The blood was dark and assumed a greenish lustre on exposure to the air and their extensive hemorrhages in the heart and intestines. Slides were made from the blood and spleen tissue and under microscopical examination the organism of anthrax were readily determined.

The disease by this time had spread into the municipalities of Santa Rosa and Cabuyao. Quarantines had been established since the beginning of the disease and the movement of animals prohibited as far as it was possible to do so. From all reports there were probably three thousand animals, including hogs, that died from anthrax in this particular outbreak. The loss to the planters was serious, since it came at a time of the year when they were preparing their land for the planting of sugar cane. Besides this, considerable loss was suffered in the rice sections of Santa Rosa and Cabuyao.

How the disease was introduced could not be learned, and from all available information the first animals in the locality of Canlubang to die of the disease were those of Mr. Navarro. That the new land which he was cultivating was infected is possible. From various sources of information it is gathered that anthrax has occurred at Canlubang in previous years. It is not beyond question of a doubt that at sometime the land which was being cultivated by Mr. Navarro may have been used as a burial ground for animals which died of anthrax.

Anthrax is more common than is usually thought of and many times reported as hemorrhagic-septicæmia when in the acute form. The different forms which it sometimes assumes make its diagnosis difficult. It is evident that difficulty may be encountered in isolating the anthrax organism from the tissues in the cutaneous or visible form of the disease.

Why this particular outbreak of anthrax was so severe has not been determined as yet. It might have been due to the increased virulence of the organism. Previous outbreaks in various parts of the islands have from time to time considerable loss, but they could not be compared with the damage that resulted in this instance.

TOBACCO GROWING IN CUBA

By DOMINGO B. PAGUIRIGAN, *Assistant Agronomist, In charge, Tobacco Investigations Bureau of Agriculture*

In the Americas and certain parts of Europe and Africa Havana cigars are considered to have no equal in the world. This world-wide reputation is founded chiefly on the fact that the fragrant Cuban tobacco is the first in quality for filler purposes and is easily recognized as the standard filler the world over, and partly on the fact that Cuba produces high class wrapper in sufficient quantities at least for her numerous cigar factories. Furnishing the two distinct types necessary in the rolling of a cigar, Cuba has a decided advantage over other important cigar tobacco countries of the world like the Philippines which produces plenty of excellent filler but has to import considerable wrapper, or like Sumatra which produce ideal wrapper only.

The history of the tobacco industry in Cuba came to be recorded for the first time as an incident following the discovery of America by Columbus. In the course of subsequent expeditions and colonizations throughout the New World, it was found that the use of this plant was commonplace among the native inhabitants. Cuba is entitled to the credit and fame that is now hers because she not only possesses an ideal climate and soil for tobacco but as the first land of appreciable size discovered fairly near the mother country, she was virtually the first to be explored, settled, and developed. The tobacco industry of the island has from the beginning proved profitable and it is not surprising to find that, in taking stock of the cigar tobacco industry the world over, that of Cuba is the most advanced.

This paper on tobacco growing in Cuba together with the writer's paper on the manufacture of Havana cigars[1] as published in a recent number of this Review has been prepared for the information of those in the Philippines who are interested in our evergrowing tobacco industry. As it was introduced into the islands by Spanish missionaries from the New World and may therefore be considered an offshoot of the Cuban,

[1] Philippine Agricultural Review, Vol. XVI, No. 1, First Quarter, 1923.

studies of present methods of the Cubans will no doubt prove interesting and instructive to Filipino tobacco planters and manufacturers.

BOTANICAL CONSIDERATIONS

The tobacco plant that is grown almost everywhere in Cuba, is scientifically known as *Nicotiana tabacum*, var. *Havanensis*. It belongs to the group of small-sized tobacco, it having an average height of 120 centimeters and its middle standard leaf measuring on the average 14 by 28 centimeters. Ordinarily, it has from 16 to 18 leaves that are harvestable. The leaf is broad but not as rounded in the tips as the Sumatra and is broadly winged at the petiole. It has light green color and tends to be thin and very pubescent when shade-grown. The position of the leaf on the stem is horizontal and the internodes are neither long nor short, the length above the middle standard being 6 centimeters. The plant tends to branch profusely at the time of flowering. Its flower is determinate, forming a racemose, loose, and spreading head.

The Cuban growers are very particular to the extent that only mother plants answering to the above description, are selected for seed but, occasionally, a sufficient number of individuals of the lanceolate variety, occur in the fields. This variety is undesirable because its leaves are very narrow and tend to be coarse in texture.

CHEMICAL AND HISTOLOGICAL STUDIES ON THE CUBAN TOBACCO PLANT

The typical Cuban leaf in the cured condition when compared with the other important cigar varieties, has a cuticle that is not so well developed as that of the Sumatra. Neither does it possess as abundant crystals as in the case of the Connecticut Havana and a typical Philippine variety, in which respect it is indeed similar to the Sumatra.

Table I gives a self-explanatory analysis of green tobacco as grown in the best tobacco district of Cuba.

TABLE I.—*Analysis of green leaves and stalk of tobacco from Vuelta Abajo District by the Virginia-Carolina Chemical Co. of Richmond, Virginia, U. S. A.*

Properties	Stalk 71.43	Leaves 80.70	Remarks
Moisture	5.00	8.78	These figures were obtained in 1903.
Phosphoric acid	.52	.62	
Nitrogen	3.50	4.64	
Potash	4.94	4.60	
Crude ash	12.76	20.10	
Lime	1.16	4.99	
Magnesia	.80	1.51	

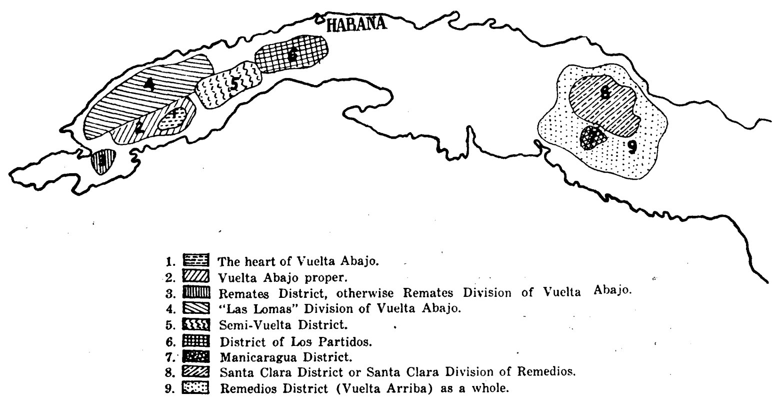
TABLE II.—*Comparative analysis of sun- and shade-grown tobacco leaves, by the Virginia-Carolina Chemical Co., Richmond, U. S. A.*

Properties	Shade-grown	Sun-grown	Remarks
	Per cent	*Per cent*	
Moisture	11.00	10.02	These figures were prepared in 1903.
Phosphoric acid	.77	.88	
Nitrogen	4.18	4.14	
Potash	2.34	4.58	
Crude ash	17.83	17.63	

As may be seen from the above table, chemically, it is advantageous for wrappers to have less moisture but more potash.

If we are to take Havana cigars as standards for smoking qualities then as verified by analysis of Rodriguez-Navaz,[1] the best must contain relatively considerable ammonia and less nicotine. According to him Cuban leaves contain 2 per cent nicotine and 3.7 per cent ammonia, whereas Virginia tobacco and Kentucky tobacco contain respectively 6 per cent nicotine and 1.53 ammonia, and 6.1 per cent nicotine and and 3.22 per cent ammonia.

A ROUGH SKETCH OF CUBA SHOWING THE TOBACCO ZONES



TOBACCO ZONES OF CUBA

No. 1.—The heart of Vuelta Abajo and the best parts of the famous *tierras bajas* (lowlands) where the best tobacco in the world is grown. This district produces tobacco consumed

[1] *El Tabaco* by M. Rodriguez-Navaz, Bailly-Bailliere e Hijos, Madrid, 1905.

PLATE I

Aspect of a shade-grown field just after first priming

only in Havana. It is light with a light aroma (mild) and an agreeable flavor. In this district are located the famous *vegas* of San Luis, Rio Seco, and Rio Hondo, including the lowlands or *llanos* of Ovas, Consolacion del Sur, and other *cuchillas*.

No. 2.—All of district No. 2 is considered a part of the *tierras bajas* or *llano de Vuelta Abajo*. The *vegas* of Baracoa, Pilotos, and Paso Viejo are considered as fine as can be produced in other parts of the island, in producing fine tobacco with mild qualities and only known to expert connoisseurs.

No. 3. Division of remates.—This section of the lowlands or *llanos* possess fine sand (*fina arenilla*) which produce aromatic tobacco. The tobacco produced in this section is uniform as to quality season after season, crop after crop, due to the peculiar conditions of its soil which is not subject to the changes in temperature. This tobacco sells readily.

No. 4.—In this section of Vuelta Abajo called "Las Lomas," there are places along the mountains which are very abrupt, which cause difficulties in the harvesting of the crops. The tobacco is not as fine as that produced in the *llano* lands. But there are points where tobacco of superior quality is grown. In the *vegas* which surround San Carlos, Luis Lazo, El Mulo, Gramales, Los Calientes, Punta de Sierra, very fine tobacco is produced. In this same district the tobacco of Montesuelo and Vinales are more heavy and are used for miscellaneous purposes.

No. 5.—The so-called section of Semi-Vuelta Abajo is neither included in the Vuelta Abajo proper nor in the Partidos District. It is the source of tobacco of thicker texture. This kind of tobacco is very strong and is used only for blending. The trade or packing center for this tobacco includes Los Palacios, San Cristobal, and Consolacion. The best *vegas* are the bases of the hills and mountains.

No. 6.—The well-known Partidos District which produces crops mainly of wrapper of light color. Because of the fertility of the red soils of the District, the plants grow considerably big and the leaves are of fine texture. The *vegas* in this district generally contain a greater percentage of wrapper leaves as compared with the *vegas* of Vuelta Abajo proper. The tobacco of Tumbaderos which is included in this district, always commands good price in the tobacco market by virtue of its well established as well as mantained quality.

No. 7.—The famous Manicaragua District which although its production is limited, it is however, of excellent quality. This district is not in Vuelta Abajo but in Vuelta Arriba. Its pro-

duct, however, compares favorably in quality with the genuine Vuelta Abajo product, and, it is quite in great demand in the eastern part of the United States. The large district Vuelta Arriba, is also known as Remedios.

No. 8.—Tobacco grown in this district is known in the Havana Market as "Santa Clara District tobacco." This tobacco is very gummy and therefore utilized generally to blend with leaves of less aroma. Most of this tobacco is exported to Germany.

No. 9.—This district is known as Remedios. Tobacco grown therein is on the whole similar and identical with that grown in Santa Clara District. The leaves are typically heavy or coarse and gummy.

CLIMATE

The climate of Cuba is typically tropical being located between latitudes 19° and 24° and between longitudes 74° and 85°. The Cuban winter is cooler than in the Philippines because of occasional North winds especially in January which brings the temperature to as low as 12° C. In the district of Vuelta Abajo, Pinar del Rio Province where the best tobacco of Cuba is grown, tobacco is in the field during the months of October, November, December, January, February, and March. During this period, the minimum temperature is 12° C. and the maximum is 30° C. Curiously enough the average rainfall in the same district during the same period falls short of 3 inches but this otherwise handicap is being remedied by pumping up the water from the small streams traversing the tobacco plantations, as occasion demands. In fact the plants in lots without the reach of the pumping systems are abnormally dwarfish for lack of water.

SOILS AND FERTILIZERS

The tobacco lands of Cuba are typically rolling and the surface soil is rather shallow so that drainage is perfect. As have been incidentally indicated in a previous topic, there are several tobacco districts which, for the sake of general classification, may be grouped geologically into three kinds. They are the sandy soils of Vuelta Abajo, the red clayey soils of Partidos, and the dark rather clayey soils of Remedios. To appreciate how the soil affects the general quality of a tobacco crop raised, we have only to consider the respective products of these three kinds of soils. Fine light leaves are raised in Vuelta Abajo, fine dark leaves under cheese-cloth or under palm leaf-shade in Partidos, and heavy dark leaves in Remedios.

Owing indeed to the irregular topography of the tobacco lands, there is not only considerable diversity in the physical

Picking seedlings that are ready to be transplanted

and chemical composition of different lots of the same farm but the drainage also becomes complicated. The lands have been so long and so intensely used without even the practice of plant rotation that without systematic fertilization and manuring, they would be worthless. Table III[1] shows complete physical as well as chemical analysis of a group of farms in the heart of Vuelta Abajo, and the following are remarks as to the proper steps observed in the application of fertilizers, as based from the analysis of the leading farms:

TABLE III.—*Physical and chemical characteristics of duban lands considered to be the best adapted in the world for the production of the cigar tobacco*

Farms	Physical analysis							
	Stone	Very Gross Sand	Gross sand	Medium Gross Sand	Fine sand	Very fine sand	Dust	Clay arcilla
1. Vivero	21.19	5.91	6.08	1.28	10.07	28.91	6.62	19.94
2. La Junta	24.47	3.90	5.73	1.98	11.63	37.58	4.08	10.64
3. Tarabico	48.25	5.99	5.49	1.65	7.03	19.69	2.90	9.01
4. Rio Seco	11.82	2.88	3.02	0.88	4.55	26.52	4.59	45.75
5. Santa Damiana	23.23	6.83	6.49	1.43	8.C0	27.76	6.91	19.35
6. Barbacoas	3.63	3.39	11.85	3.20	16.85	42.81	6.55	11.72
7. San Luis (Hato)	30.07	3.54	5.01	1.41	8.38	23.00	8.39	20.20
8. Tarabico (Caguazo)	10.09	3.94	17.80	11.67	29.89	15.55	1.26	9.80
9. Santa Damiana (Laguna or low)	.32	1.32	3.03	1.00	2.73	14.73	3.99	72.89

Farms	Chemical analysis							Fertilizer applicable		
	Nitrogen	Phosphoric acid	Potash	Sodium	Lime	Chloride	Organic matter	N	P_2O_5	K_2O
1. Vivero	0.15	0.19	0.12	0.040	0.25	0.003	2.23	4	9	7
2. La Junta	0.14	0.15	0.11	0.058	0.22	0.003	1.39	4	8	7
3. Tarabico	0.12	0.27	0.10	0.049	0.22	0.003	1.94	4.5	7	9
4. Rio Seco	0.13	0.19	0.11	0.049	0.27	0.003	2.41	4.5	9	7
5. Santa Damiana	0.15	0.16	0.10	0.051	0.22	0.003	1.89	4	8	8
6. Barbacoas	0.12	0.16	0.01	0.023	0.16	0.004	2.58	4.5	8	10
7. San Luis (Hato)	0.17	0.29	0.02	0.019	C.40	0.004	3.31	4	6	10
8. Tarabico (Caguazo)	0.04	0.04	0.05	0.007	0.13	0.001	0.44	......	......	......
9. Santa Damiana (Laguna or low)	0.16	0.23	0.13	0.134	0.11	0.007	3.28	......	......	......

NOTE.—These lands or farms are properties of the Cuban Land and Leaf Tobacco Co. With the exception of the last two (Nos. 8 and 9) all of these farms produce excellent tobacco, especially the farms of Tarabico and Rio Seco. Analysis of farms Nos. 8 and 9 are included here merely with the object of showing how lands, even in the same vicinity, may vary considerably. The fact that expert tobacco buyers in Cuba judge primarily the merits of a crop of tabacco by the farms rather than by regions, is obvious.

SANTA DAMIANA FARM

Potash.—The soils of this farm are not very high in potash.

Iron and alluminum.—The content of these elements is not very high.

Phosphoric acid.—The content of this is very different in the different sections and reaches in lot No. 5 the triple height of lot No. 1.

Lime.—The amount of lime is not very high and can scarcely be considered sufficient, except perhaps No. 4.

[1] From the records of the Cuban Land and Leaf Tobacco Co., Havana, Cuba.

Magnesia.—This reaches a considerable height only in lot No. 1 but in all others it is not too high.

Sulphuric acid.—This is very high only in lot No. 1 with 0.09 per cent but care should be taken to bring as little as possible sulphuric acid in the soil, selecting well the raw materials for the fertilization.

Nitrogen.—This element reaches a normal height of 0.2 per cent in most of the lots so that a normal or slightly increased fertilization in nitrogen should be sufficient.

TAMARINDO FARM [1]

The soils of this plantation show well in physical as in chemical analyses the most satisfactory content of all, except in potash where it is a little low. But this can be remedied by increasing the potash fertilization. An application of lime at the rate of 200 to 300 pounds per acre every year, would also do good by neutralizing the acidity of the soil. The lime for this purpose should contain 70 to 75 per cent of lime and not over 2½ of magnesia. For all the other regular fertilization should be applied.

VIVERO FARM

Potash.—There is a medium amount of this in the soils but it can be considered high enough for producing a satisfactory plant. A fertilization in potash or medium height will be always necessary.

Iron and alumina.—Middle high not excessive.

Phosphoric acid.—This is comparatively high in all the soils of this farm. It seems that the acid is not natural in this soil in that height but that it is brought and has accumulated by fertilization. Therefore it would be well to make a comparative fertilizer test in the fields in order to determine whether the normal fertilization with phosphoric acid is still necessary.

Lime and magnesia.—As far as these two are concerned this farm shows best proportion and content but on account of the total absence of carbonic acid and the sour nature of the soil a moderate dose of lime will be of benefit. Care should be taken to use the lime that contains as little as possible of magnesia.

Nitrogen.—This is fair and a normal fertilization should at least be enough for lots 1 and 3. Lots 2 and 4 should have some increased nitrogen.

RIO SECO FARM

Potash.—With one exception this is very high and therefore the fertilizer should contain enough of that plant food.

Iron and alumina.—With the exception of lot No. 6, these substances are not very high.

Lime and magnesia.—The proportion of these two is all in all not bad but does not reach the ideal amount. Taking into consideration the sour nature of the soil a good dose of lime containing not over 2½ per cent magnesia will be very useful.

Phosphoric acid.—The content of the acid is over normal in lots 5 and 6. Care should be taken to let the acid accumulate as much as possible in the soil by using a fertilizer with a minimum content of that stuff.

---

[1] Subdivision of Vivero farm.

(a) Furrow fertilizing

(b) Fixing fertilizers in the furrows with an ordinary field cultivator

Nitrogen.—This is normal with the exception of lot 6 and normal fertilization should be used.

TARABICO FARM

Potash.—This is fair in lots 1 and 4 but very low in lots 2 and 3. Those two lots should have an increase in fertilization.

Iron and alumina.—Fair in four lots.

Phosphoric acid.—Very poor in lots 3 and 4. In others not too much content either. The soils of this farm most probably would answer very well to a higher phosphoric acid manure.

Lime and magnesia.—Low content requiring the application of lime.

Sulphuric acid.—This acid is very high and special care has to be taken in the selection of the raw materials.

Nitrogen.—Content not very high with the exception of lot No. 1 and a strong fertilization should specially be given to lot No. 3.

Considered from the standpoint of the whole the soils show well in the physical as in the chemical tests of a fair appearance. Where potash and phosphoric acid are contained in higher proportions it is shown that they are brought in by fertilization. All in all a normal dose of fertilizer should be given and, where exceptions seem necessary, they are stated above. As the content of lime is low in all the soils and they all show a sour reaction, the use of good, if possible, air-slaked lime with not more that 2½ per cent magnesia in maximum will be of benefit.

The Philippines and Sumatra might as well congratulate themselves because the fertilizer problem which is a big item by itself, does not confront them. Old Mother Nature is very generous to them. In the Philippines there is the almost yearly overflow of the Cagayan River, spreading over the tobacco fields not only silt but decayed and humic materials from the surrounding hills and plateaus. In Sumatra the land is so plenty that the planters could affords to let the land lie fallow as long as eight years. However, with the perhaps good or better prospects in the future of the Philippine tobacco industry, the raising of the crop may be extended into uninundated territories. It is only proper to look into the future and who knows that but a lesson on the application of fertilizers for tobacco will have to be timely.

Because of the fact that the lands in Cuba are by now practically exhausted of their original fertility, for sometime past the Cuban planters have been obliged, as the only way whereby they could keep their tobacco lands in proper form, to apply regular yearly rations of commercial fertilizers. Curiously enough with the use of the same formula season after season, the yield and the quality of the product have been more or less maintained according to the standards of the industry. The

physical as well as the chemical characteristics of the best tobacco farms found in the island have already been given and the formulæ, quantity, nature, and methods of application of the fertilizers generally used will be given next.

There are three forms of fertilizers used: stable manure, green manure, and commercial fertilizers. Stable manure is used ordinarily and is spread over the fields with spreading machines immediately after harvesting at the usual rate of 10 tons per acre, that is, during the months of April and May. Green manure is employed only when the prices of nitrogenous fertilizers are very high. Obviously leguminous annuals, especially velvet beans, are planted for the purpose. Stable manuring and green manuring are practised only in the fields, never in the seed beds.

Commercial fertilizers are applied by broadcasting on the seed beds and on the fields, and by placing in rows 4 or 5 days before transplanting.

The most popular formula used by tobacco growers in the district of Vuelta Abajo is the following:

	Pounds
Cotton seed meal	800
Double acid phosphate	200
Potassium carbonate	200
Total	1,200

When broadcast on the fields, this formula is applied at the rate of 1,200 pounds per acre and, when on seed beds, the rate is reduced to 500 pounds. It is also reduced to 500 pounds when applied in the furrows. The Estación Experimental Agronómica at Santiago de las Vegas recommends the following essentials:

	Kilos
Phosphate fertilizer	500
Nitrogen	300
Potash	500

The above is recommended for broadcast preliminary fertilizing of a hectare or 2½ acres of tobacco land. In addition to this, just before transplanting, it is also required that the furrows should be fertilized at the rate of 1 or 1½ arrobas (arroba= 25.351 pounds) per 1,000 seedlings with a mixture containing

	Per cent
Phosphoric acid	8
Nitrogen (ammonium)	4
Potash	8

Cuban prevailing methods of transplanting

As a supplementary information, Table IV is given showing six other formulæ or mixtures generally employed by the tobacco growers of Cuba.

TABLE IV.—*Cuban fertilizer mixtures*

Mixture series fertilizers	1	2	3	4	5	6
	lb.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
Cotton seed meal	1,000	1,000	1,000	1,000	2,000	....
Tobacco powder	1,000	1,000	1,000	1,000	800	....
Carbonate of potash	320	400	200	....	....	....
Double phosphate	80	....	....	....	....	375
Sulphate of ammonia	....	....	....	....	....	375
Ammonium phosphate	....	....	....	1,000	....	....
Superphosphate	....	....	200	400	600	....
Sulphate of potash	....	....	....	600	700	500
Guano	....	....	650	....	....	....
Total	2,400	2,400	3,050	4,000	4,100	1,250

A common practice in Cuba is that at least about one-half as much sand or dry earth is added to the mixture before application is made. Mixture No. 5 is the favorite in case the land has been previously dressed with stable manure while mixture No. 3 is the common preliminary dressing. Otherwise all the mixtures are primarily for furrow fertilizing.

SEED BEDS

The land selected for seed beds are made ready as early as in the months of April and May. There are two kinds of seed beds prepared. For planting in a small scale, the beds are surrounded with wooden supports set up perpendicularly so as to avoid washing away of the seed and to facilitate the picking of the seedlings at the time of transplanting. For planting in a large scale, the beds are without supports at the borders, only the patches separating them are made deeper and their surfaces slope slightly and gradually from the middle to the edges. The beds are called "canteros." They are usually three feet wide and from one to two feet apart. The length is not fixed, being subject to the drainage of the land.

The Cubans still practise making seed beds in the mountains or forests. No planter could give a satisfactory reason for such conservatism, except that good results are always obtained. Evidently the virginity of the land dispenses with the use of commercial chemical fertilizers and forestalls the fungus ravages so common among open land seed beds. Incidentally, in the clearing of forest seed beds, the burning of the cut dried brush and wood over them sterilizes the ground to a certain extent besides destroying eggs and broods of destrutive insects and their allies.

The real preparation of the beds on the open ground begins in the month of August when the seeds are first sown. The ground is powdered as thoroughly as possible and the surface smoothed well preparatory to sowing. At first the beds are covered with a double layer of cheese-cloth (10.12 mesh) to hold the seed firmly to the ground and to reduce the heat of the sun. Watering is done every day. After 15 to 20 days the cover is removed. By this time the seedlings already have 4 leaves at least.

At least ten showings are made at the plantation of the Cuban Land and Leaf Tobacco Co., in Pinar del Rio Province, which grow ordinarily 315 acres of both shade- and sun-grown tobacco. Sure heavy rains and possible cyclones are the reasons for the arrangement. According to the records of the Manager of the plantations, under normal conditions, seed sown at the following different dates should be ready to be transplanted in about two months as indicated:

Time of sowing	Time ready for transplanting
August 12–15	September 20–October 12.
August 20–28	October 5–12.
September 5	October 20.
September 10	October 25.
September 15	October 30.
September 20	November 5.
September 25	November 1C.
September 30	November 15.
October 5	November 20.
October 1C	November 25.

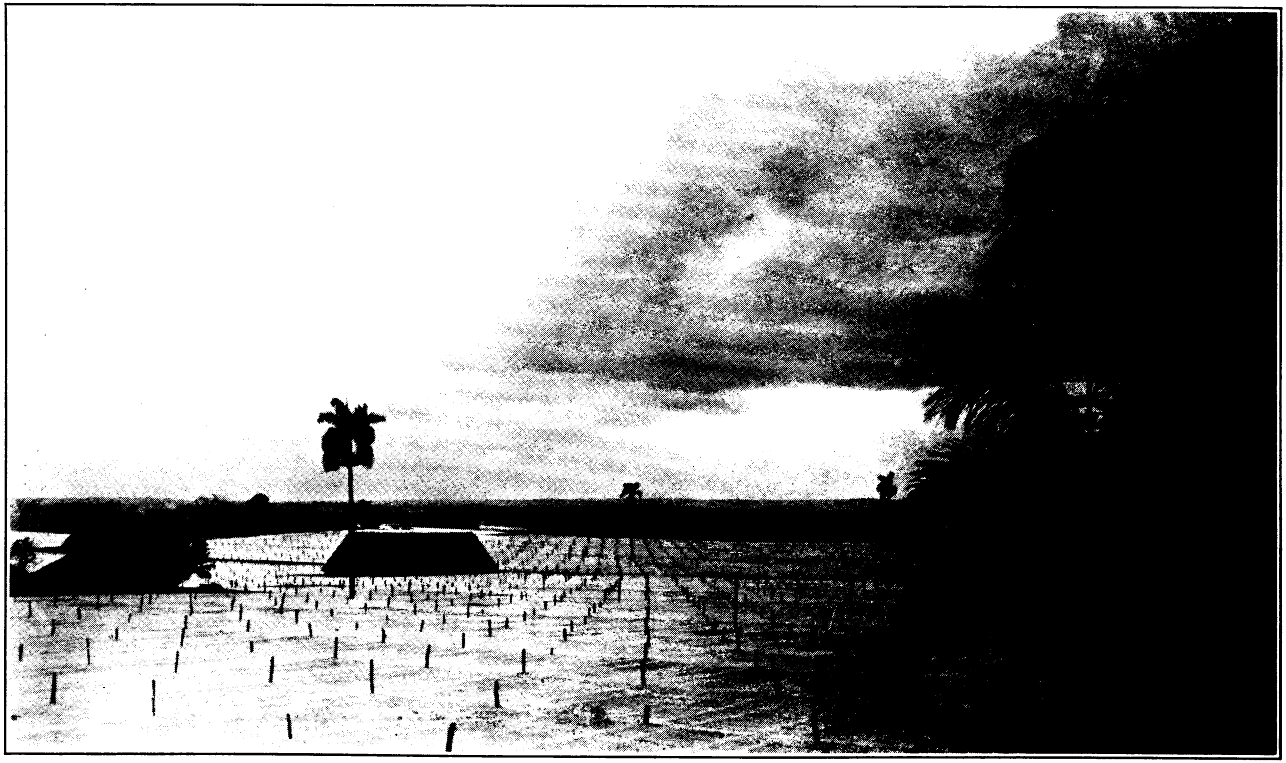
It may be noticed from the above that the intervals are uniformly 5 days.

The seed is sown very sparsely and mixed with the chemical fertilizer in the ratio of one-half ounce of seed to 20 pounds of the latter. About an ounce of seed is generally sown on a bed 3 feet wide and 15 to 20 feet long. The idea is to allow at least an inch square to a plant.

Watering is done by spraying high so that the water falls on the beds as by rain. Otherwise can sprayers are still in use.

Until transplanting time, the beds are kept scrupulously clean by weeding them daily. For this work the women and the older children of the plantations are employed very effectively. Weeds and grasses are removed by cutting with an ordinary knife their roots half way before pulling. This method is sensible as it avoids breaking the ground and allows the normal growth of the surrounding tender seedlings.

The reference has been made in a previous topic to the effect that only commercial chemical fertilizers are applied to seed



Panoramic view of extensive tobacco fields covered with cheese-cloth

beds. The reason is to avoid fungous attacks, for they provide no culture medium in the form of decaying materials.

PREPARATION OF THE FIELDS AND THE CONSTRUCTION OF SHADE TENTS

The production of tobacco under artificial shade is now the order of the day in Cuba. However, by far the greater part of the yearly crop is grown in the open. As far as the preparation of the ground is concerned there is no material difference between the two methods of culture, with the exception perhaps that the shaded land requires more irrigation. In the open the plants are set out a little closer.

Unless the planter decides to plant a crop of legumes for green manuring, the ground is not touched until nearly transplanting time. In this way all kinds of weeds and grasses are allowed to thrive only to be plowed under. The ground is usually plowed from 3 to 5 times depending on rainfall. In the bigger farms all the tools and implements are of up-to-date American makes, from the manure spreader to the tractor. The first plowing is either done with a two-disc plow or with the ordinary one-share steel plow. Harrowing is done only with double-action tractor disc harrows. Ordinary tooth harrows, however, are still in use, especially among the small planters. Good tilth is obtained by crossplowing and cross-harrowing. Should rain fall after the land has been already made ready for transplanting, good tilth is restored by replowing and reharrowing.

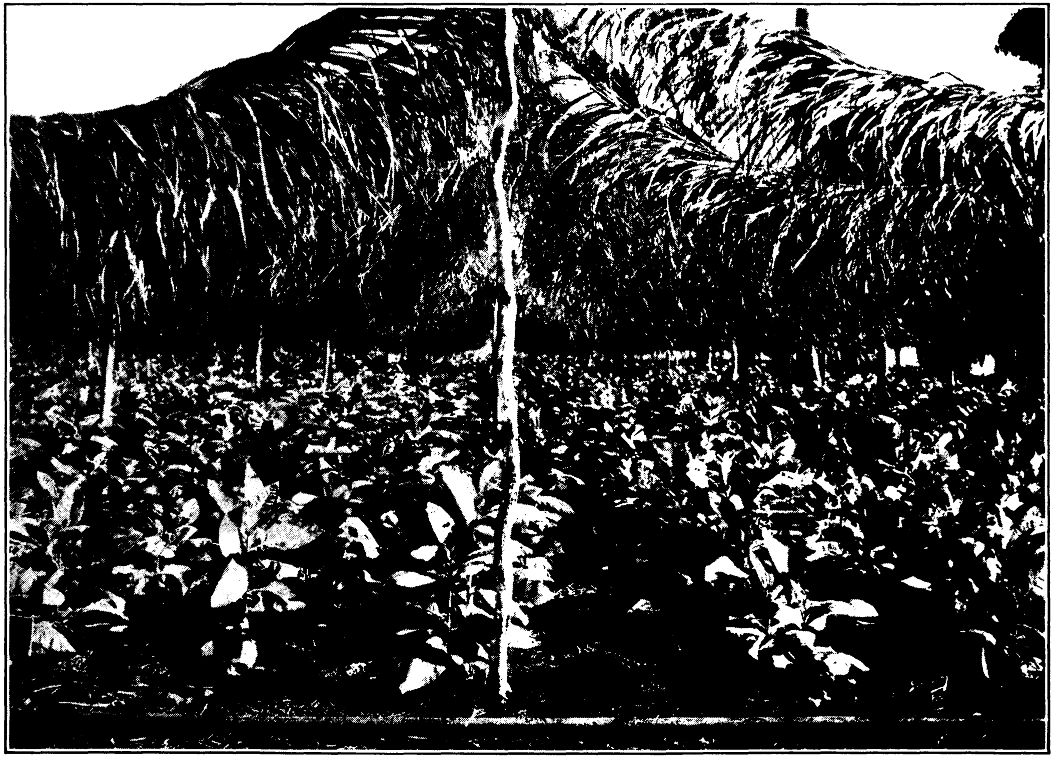
The construction of shade tents is a very expensive proposition but the ultra high prices paid for Cuban tobacco warrant the extra expenses incurred. Artificially shade-grown leaves possess all those qualities that go to make highly valued wrappers—size, fine texture, and light uniform color. A bale of Vuelta Abajo tobacco, weighing between 80 to 90 pounds, readily sells at from \$100 to \$500. Partial shading is either obtained by the use of cheese-cloth, 12-mesh to the inch, or by the use of royal palm leaves.

The following are the essential materials for the construction of a cheese-cloth tent covering an acre:

187 posts, at least 9 feet long and at least 2 x 4 inches.
20 hard wood stakes.
300 lineal feet of boards, 1¼ x 4 inches.
300 lineal feet of boards, 1 x 6 inches.
300 pounds of No. 10 soft galvanized wire.
5,100 square yards of cheese-cloth.

In the first place, the ground is not necessarily very regular but the posts are placed on straight lines and at right angles. The wire is first run parallel with the general direction of the field from end to end. At one end a square corner is established by measuring 80 feet along the wire and a stake is placed at the finishing point. From the same starting point 60 feet is measured off at right angle to the wire and another stake is placed. The resulting distance between the two stakes is usually exactly 100 feet. The wire is next stretched from the corner through the 60-foot mark to the corner on the other side of the field which is subsequently squared off in the same manner. The posts are then placed along the wires around the field at least 200 inches apart and buried $2\frac{1}{2}$ to 3 feet. Boards ($1\frac{1}{4}'' \times 4''$) are next nailed on the upper ends of the outer rows of the posts, so that these are connected with one another. The wires are afterwards stretched from post to post across the field in four directions. The wires are stretched beyond the outer posts to hard wood stakes placed 10 feet outside and parallel to each outer post. By this arrangement the wires can be tightened at any time by twisting the wires between the posts and the stakes. After the wires have been stretched, the rest of the posts are placed in the same manner as the first ones, where the wires cross so that they are also 200 inches apart each way. Two-inch staples are used for fastening the wires to the posts. In many cases two more wires crossing the first ones are stretched in different directions passing on the top of each post and stapled likewise. Unless the framework with the wire is intended to be permanent, the use of extra wire is hardly necessary because the fields are not shaded all the time.

The cloth is always 200 inches wide, hence the convenience of having the posts set 200 inches apart each way. It is first drawn along the top of the wires, piece by piece and the edges are sewed just over the wires with an ordinary cotton twine used double. Some planters sew securely the cloth by inclosing the wire in the seam but ordinarily and for economy's sake, the cloth is simply securely fastened at the middle of the wire stretch between every two posts. At the end of each season the cloth is removed and sored. At the base of the outer posts boards ($1'' \times 6''$) are nailed. The sides of the tent are also covered with cheese-cloth, allowing at least two opposite doors, at the nothern and southern sides. The doors are smaller than those used in Connecticut because carts are not allowed to enter the tents in Cuba. The cloth from the business standpoint is



Partial shading with royal palm leaves is used successfully as a substitute of the cheese-cloth

good only for two seasons. In Cuba, ladders are not employed either as in Connecticut in fixing the wires and the cloth at the top of the framework of the tent because men trained in the use of wooden stilts are always available.

In the Partidos district the cheese-cloth is being successfully substituted with royal palm leaves placed on posts similarly placed in fields as for cheese-cloth tents. The leaves are stretched from post to post and the work is finished. From above the structure when finished resembles an anormous checker-board.

The use of wind-breaks in Cuba is very common owing to occasional winds and dusts in case the tobacco fields are close to the roads. Discarded cheese-cloth and corn planted in every twentieth row, are the common wind-breaks.

TRANSPLANTING

Transplanting begins as early as about the middle part of the month of October, from seed beds sown in August. Transplanting, however, does not become very general until sometime in November, when all the seed beds in the islands are crowded with men, women, and children, busy pulling the seedlings and tying them into bundles of one hundred each with fiber from the leaves of the royal palm. If the seed beds are far from the plantations, the bundles are collected in the ordinary Cuban pannier and carried on horse back, or by cart or wagon.

The furrows are made only at the time of transplanting, as fast as the planters can work. The idea is to avoid as much as possible evaporation from the soil. For the work of transplanting, crowds of women, men, and children are also employed. The children and women distribute the plants along the rows and the men planters follow them just as fast as they go. The plant is picked up with the left hand, at the same time a small hole is opened with the right, the plant is inserted in the hole, the roots and the lower part of the stem is covered, and with a little final pressure the planting operation is finished.

The method just described is the old and prevailing one in Cuba but only during the last season (1921–1922), a new method of transplanting, called by the Director of the Estación Experimental Agronómica, "Argudin-Lorenzo" in honor of the originators of the idea, was successfully inaugurated.

The new method consists in first letting the water flow freely along the furrows just prepared, thus saturating the furrows. While the ground is under this condition, a hole is made by

merely inserting the index finger, and the plant placed in it without any further ceremony except that within the following four or five days, the water is again allowed to flow freely along the same furrows and dry earth is subsequently placed around the plant. It is contended, as the crop of the last season has demonstrated, that this method not only reduces the cost of transplanting to one-half at least but apparently it has solved the important problem of the "pasador," an Elaterid beëtle, which usually attacks newly transplanted seedlings by eating its way through the tender stem, ultimately killing considerable numbers of young plants. Apparently, however, as has been observed during the same season, the "pasador" refuses to perform its attacks in a saturated ground and when the stem of the tobacco plant is no longer so tender because afterwards when the ground was again dry, the beetle failed to make its usual ravages.

Under shade the plants are set one foot apart in rows from two to three feet apart. In the open, the distance between the rows may be the same as under shade but the distance between the plants in the rows is usually less, about 9 inches. The idea is to get some wrappers from the sun grown crop from the lower standards.

CULTIVATION AND WATERING

Cultivation is done only by hand with a broad-bladed and short-handled native hoe called the "guacate." At least three cultivations are made during the whole growing period of the tobacco plant in the field at intervals of about 15 days. Ordinary hand cultivators are sometime resorted to in case the ground happens to be too compact.

The first cultivation is usually performed when the young plants have three or four leaves already spreading and the stirred dirt is placed around the plants including the cut young weeds. The second and the last cultivation are mere repetitions of the first except that by the time of the last, the furrows have become converted into high ridges.

Watering is hardly the term to apply for in Cuba water is now supplied to the plants by extensive systems of irrigation. Most probably due to the gradual deforestation of the mountains, the average rainfall in Cuba is so low that the meagre water supply of the small streams has to be pumped up. The irrigation projects are usually in the hands of powerful companies. Only average engines are utilized owing to the small

Aspect of a shade-grown field at the time of the third priming and methods of handling harvested leaves

size of the streams. A number of these engines are operated at the same time, and each one cover distinct territories.

The fields are usually irrigated from 2 to 3 times during the growing of the plants. As in cultivation, the interval is usually about 15 days for shade-grown crops, but the last time is always done from 2 to 3 days just before the first priming or the beginning of harvesting. For crops in the open, the interval is 16 days.

TOPPING AND SUCKERING

Topping and suckering are general, that is, they are always performed, for, considering the fact that the lands of Cuba have been so intensively used for years, unless these practices are strictly observed, the leaves cannot normally develop. Topping commences as soon as signs of flowering begin to become manifest. But if the general growth of the plants is far from promising, topping is begun considerably earlier. Suckering, of course, takes place simultaneously with topping because the moment the plants are topped, suckers and axiliary buds begin to appear like mushrooms. The work of topping and suckering is done by hand, usually by children and women.

HARVESTING

There are two methods of harvesting the tobacco crop in Cuba. Tobacco grown in the open is harvested by cutting the stalk into as many times as there are pairs of leaves, with a pruning knife at right angles. This method is identical in principle with the method of harvesting the whole stalk as practised in the United States. The method of harvesting by priming is invariably employed with shade-grown crops because the growers cannot afford to risk losing after having spent so much and because obviously the method of harvesting the leaves one at a time as they gradually ripen, is the logical way.

In harvesting by the first method, the planters wait until standards are ripe. Therefore it usually takes place considerably later than the second method.

In harvesting by the second method, the middle standards are taken first as it is the experience among the growers that only thus they obtain the best wrappers. Thereafter, priming is carried on at intervals of from 6 to 10 days until all the leaves of a plant are primed. The leaves are primed in this order: (1) middle standards, (2) lower standards, (3) upper standards, and (4) top leaves. The sand leaves are seldom utilized.

The Cubans believe that harvesting at the proper time is a delicate matter. And as a matter of fact the operation is always performed under the strict direction of experienced foremen. Among ripening indications whereby Cubans are guided, are: (1) the typical Cuban tobacco plant, possessing as it does light green leaves, undergoes a general change in color, especially that of the standards and the top leaves, to much lighter green; (2) the standards become less pubescent; and (3) the veins, viewed dorsally, present a pearly white appearance. Apparently, however, the Cuban growers adhere very much to time inasmuch as in spite of these indications becoming manifest early, harvesting is not begun. It is claimed that too much water, abundant amount of fertilizers and the wind, separately or collectively, are responsible for bringing about premature indications of ripening. Harvesting takes place as a rule from 50 to 60 days after transplanting.

POLING AND STRINGING

Plants grown in the open on the average have only 5 or 6 pairs of marketable leaves each. Each cut of the stalk with a pair of leaves is called *mancuerna*. The *mancuernas* are made to ride side by side on long poles about 12 feet in length—long enough to carry at least 120 *mancuernas* or 240 leaves. The poles are not directly taken into the curing barns, but are placed on wooden supports about 5 feet above the ground, and remain in the sun at least one day. Sungrown leaves, being obviously coarser, are required to wilt and partially dry first in the sun. In many instances when the leaves are very coarse in texture, they are kept in the sun more than one day.

The supposedly best wrapper leaves from the shade-grown crops are strung with an ordinary cotton twine and a suitable steel needle, face to face and back to back, and are hung on short poles made usually from pine wood. These poles measure 50 inches long by ½ inch thick and by 1 inch wide. The leaves are strung from ½ to 1 inch apart and hung at once on convenient racks in the curing barns. Only 36 leaves are strung to a pole in this way. The poles are so placed on the racks so that the leaves of two poles do not brush one another. The lower grades of wrappers, composed of lower standards principally, are strung in a different way. They are strung naturally folded and so placed alternately to ride on long poles with the ventral surface facing down. Only 240 leaves, as in the case of the *mancuernas*, are strung to a pole which is from

Time for topping

1 to $1\frac{1}{2}$ inches in diameter and about 12 feet long. These are taken immediately into the curing barns.

Poling the *mancuernas* is done only by men, while stringing is exdusively done by the women.

"MAMON" AND "CORONAS"

After harvesting, the stalks of the main plants are cut as close to the ground as possible and one promising sucker for each plant is allowed to develop. The limited crop produced by this second growth is called *mamon* locally. The leaves are festooned on miscellaneous cords and dried or cured on the outside of the walls of the native huts. These leaves are packed after curing and sold as cigarrette tobacco, known in the trade as *hojas de semilla.*

The term *coronas* is the literal Cuban equivalent of the English "top leaves." But inasmuch as the crop grown in the open is harvested by cutting the whole stalk at the same time, the term is limited now to the two or three top leaves of plants grown under shade. These leaves are not included with the rest because of their coarse texture. As a matter of fact when harvested they are cut in *mancuernas* and handled in the same manner as tobacco grown in the open. These leaves when cured are sold in the market as *coronas* still and are utilized by the factories usually as cigarette tobacco.

The sand leaves proper are called *libras de pie* and are harvested latest. These are gathered and treated as in the case of *mamon* leaves, and when cured, are sold for blending purposes in the making of cigarettes.

CONSTRUCTION AND MANAGEMENT OF TOBACCO BARNS

Curiously enough, the tobacco barns of Cuba are constructed lengthwise from east to west. They are usually built of mixed materials to a size capable of housing conveniently the leaves from an acre of sun-grown tobacco or from two acres of shade-grown.

Even if the walls of a curing barn is made from first-class wood, the roof is always of either royal palm of palmetto leaves. The barn is 30 meters long, 14 meters wide, 8 meters high to the ridgepole, and $3\frac{1}{2}$ meters to the leaves. It has 4 or 5 large windows on either side and 2 smaller windows and one large door on either end. The interior of the barn is made entirely of racks capable of holding at least 25,000 small poles (*cujitos*) at one time.

It is claimed that the reason for the east-and-west arrangement of the barns is to minimize the possible strong heat of the sun. And the universal use of the palm roofing is justified by the moisture absorbing capacity and non-heat conductibility of the material. It is of course admitted that the material is sadly very combustible. Indeed it is during the curing period that the Cuban growers begin to observe the greatest caution.

Light rays, air currents, or winds and humidity are the atmospheric factors which the planters are very careful in controlling. Obviously the sole objective of the planters is that the leaves should slowly and naturally cure. Light rays and winds accelerate evaporation in the first place and consequently causing the leaves to dry sooner. Humidity checks evaporation and furnishes favorable condition for the dissemination of fungi, causing pole sweat and pole rot.

The first two factors are easily controlled through the judicious management of the doors and windows. But humidity control is indeed a difficult problem. It is considered that a relative humidity of from 70 to 75 per cent is sufficient. Hence, when the relative humidity falls very low or goes higher, to check faster evaporation by the first and to check excessive moisture by the second, the barn is closed as tightly as possible. But in the evening with the relative humidity becoming normal, the doors and windows are kept as widely open as possible. As high relative humidity takes place only in the evening or during rain storms, the barns are kept well ventilated as soon as the sun shines. As humidity control is invariably the most important problem confronting the planter during curing, the barns are always built on well drained sites. And among the well-to-do planters, the ground inside is carpeted with concrete.

After 50 to 60 days in the curing barn, the leaves are ready to be fermented. When an ordinary curing barn is provided with a wooden or cement floor, it is also utilized as a fermentation house. Otherwise the leaves are removed to a strong large warehouse of the plantation for fermentation. The ordinary Cuban tobacco warehouse is built of brick or concrete and roofed with galvanized iron. The windows are very large and numerous. In this respect, it is probably built for dual purposes. The numerous windows furnish plenty of illumination for the leaf (classifyers) sorters and its spaciousness and strength accommodates safely a bumper crop.

SEED SELECTION

In an earlier topic a description of the type of the tobacco variety as grown in Cuba has been given in detail. With

Exclusive wrappers are strung back to back and face to face at the rate of 36 leaves to a pole. Notice the cheesecloth shading to the right

the insignificant exception of occasional appearances of a few individuals of the Porto Rican (*Lancifolia*) variety, only one variety is grown now although there was a time following the ten years' war when the introduced Mexican tobacco (variety *Macrophyllum*) threatened to completely displace the native *Havanensis*. The Mexican variety in the first place is a rank grower, having large heavy leaves and large and copious fruits. In the return of peace and because smokers always insisted on "light smokes," the Cuban growers with the coöperation of the Estación Experimental Agronómica at Santiago de las Vegas, did their best to exterminate not only the undesirable Mexican variety but all other varieties, native or foreign, and to grow only seed from the native *Havanensis* which, although almost lost, was fortunately found making a last brave stand in the more remote and isolated farms in Pinar del Río Province against the invincible *Macrophylla* and the no less strong *Lancifolia*. A law was even passed calling for the destruction of all exotic tobacco varieties.

The *Havanensis* today reign supreme all over the island although it must be admitted that a few mongrels are still to be found. Indeed, if one is curious to see it in all its glory, he is only to visit the test plots of the Estación Experimental Agronómica sometime in January or February, where the strain is maintained as pure as ever through continuous inbreeding.

As all foreign varieties are practically eliminated, paper or cloth bags for flowers, are no longer used in Cuba except at the experiment station. Seed for the next crop is raised by setting aside a more or less isolated plot for mother plants only. These plants are not topped and the leaves are harvested only after the majority of the fruits begin to show signs of maturity. At maturity the seed pods are cut and dried in the sun from 3 to 5 days. Afterwards they are hung for further thorough drying in the curing barn or in the warehouse from 8 to 40 days. The capsules are separated and beaten with strong bottles or wooden bats. The seed is separated from the shell with a sieve, placed in hermetically sealed containers, and stored away until sowing time.

DISEASE AND INSECT PESTS

The usual diseases and insect enemies of the tobacco are also found in Cuba. Damping-off (*Pythium sp.*) is the chief fungus disease of the seed beds. The mosaic disease seems to be the only one of importance in the fields. Leaf spots of all kinds and occasional wilts are sometimes observed in the fields but

since no appreciable damage is done hardly any attention is paid to them. As already pointed out, damping-off is partially forestalled by the use of chemical fertilizers in seed beds. The Estación Experimental Agronómica has successfully controlled the disease by either sterilizing the ground with (1) a double application of boiling hot water or (2) with 5 gallons of 40 per cent formalin applied to every 1,000 square feet of ground. The station also recommends the spraying of 250 gallons of Bordeaux Mixture to every 2,000 square feet of seed beds. The solution is prepared with 30 pounds of copper sulphate and 75 pounds of lime.

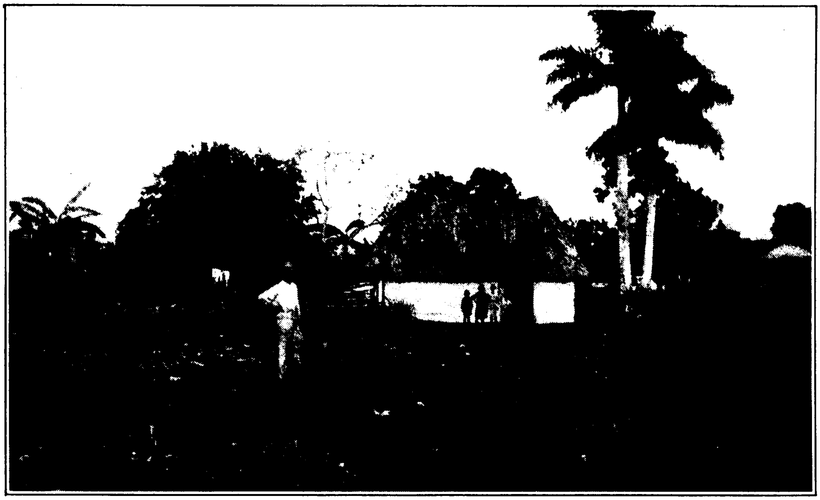
The most important insect enemy of the tobacco plant is the *pasador,* an *Elaterid* beetle. As pointed out already, only until recently by the adoption of the "Argudin-Lorenzo" method of transplanting, all efforts to control the pest had failed. Worms of *Lepidopteras* of all kinds, flea beetles, and bugs are constant guests of the tobacco fields. Beside hand-picking, when the plants are about a month old in the fields, they are dusted with Paris green mixed with corn flour as bait (1 ounce or a spoonful of Paris green to 25 pounds of corn flour). The experiment station, however, gives preference to a weak solution of lead arsenate because of its obvious advantage over Paris green in persisting on the leaves in spite of the rains, besides affecting less the leaves as does Paris green. Arsenate of lead is mixed thoroughly with water at the rate of one ounce to one gallon of water. In Cuba insecticides are applied only when the plants are very young as it is feared they would affect the quality of the harvested leaves.

COST OF PRODUCTION OF LEAF-TOBACCO

The Cuban planters can afford to operate their farms at high rates of production by virtue of the high reputation of their product and the high prices paid for it. The data[1] in Table VI represent the cost of leaf-tobacco production per acre of shade-grown and for sun-grown. The figures are carried as far as the curing of the leaves only, because the prevailing method of leaf-tobacco sale as far as the planters are concerned, is to sell leaves on poles, a practice identified with that of selling on "palitos" in the Philippines. The work of fermentation, classification, and baling is left to the buyers who are usually manufacturers at the same time.

---

[1] The data given here were made available to the writer through the kindness of Don Jacinto Argudin, sr., the able and veteran manager of the choice and extensive tobacco lands of the Cuban Land and Leaf Tobacco Co. at San Juan y Martines, Pinar del Rio Province.



(*a*) A "veguero" or tobacco farmer at home

(*b*) The "Mancuernas" are made to ride on poles and exposed in the sun during the rest of the day

TABLE VI.—*Cost of leaf-tobacco production per acre in Cuba*

[Sun-grown tobacco]

Total cost of production per acre	₱727.40
Fertilizers:	
10 tons of manure at ₱10	100.00
20 sacks (25 pounds each) commercial fertilizers at ₱3	60.00
Wholesale price of 20,000 seedlings	60.00
Transplanting expenses	30.00
Plowing—5 times	40.00
Cultivation—4 times	80.00
Irrigation—4 times	36.00
Topping and suckering and worming	40.00
Harvesting	20.00
Poling and hanging of poles in barn	100.00
Depreciation on poles 5 per cent	1.40
Depreciation of barn 5 per cent	160.00

[Shade-grown tobacco]

Total cost of production one acre of shade grown	₱1,147.40
Cost of ordinary field operations	727.40
Depreciation of cheese-cloth—50 per cent	200.00
Depreciation of other tent materials—10 per cent	20.00
Labor for erecting tent and removal of cheese-cloth yearly	200.00

It is clear that the cost of producing Cuban tobacco in the open is almost four and a half times that of the cost of producing tobacco in Isabela in 1916 when prices were quite high. In that year it cost in round figures ₱8 to produce a fardo, or ₱160 per acre.

CONCLUSION

Despite the fact that the Cuban tobacco is a small-sized variety, the independent growers of Cuba limit their acreage to one acre. Seldom, if ever, does a family undertake to plant more than one acre. With this arrangement the crop could be properly taken care of and but very little trash finds its way into the market. Moreover, the task of the grower in Cuba is not as extensive as that of the Filipino for it stops when the leaves are ready for fermentation and classification.

The cured leaves are brought into the warehouses, still hanging in poles. One decided advantage of this practice is that it prevents any attempt on the part of unscrupulous growers to commit any mischief and fraud. If adopted in the Philippines, it will mean saving of time and money for the growers and dealers, as it will do away with the duplication of the work of classification and preparation of hands (*manos*). As practices now prevail, the growers classify and prepare the leaves of their

crop into neat hands, and the dealers unbind them and repeat the operation.

ACKNOWLEDGEMENT

I wish to acknowledge my indebtedness to Henry, Clay, and Bock & Co., Ltd., of New York, for permission to avail myself of the facilities afforded by their numerous factories and plantations in Cuba; to Messrs. Jacinto Argudin, sr., Jacinto Argudin, jr., and Rafael Martinez, all of the Cuban Land and Leaf Tobacco Co., of Havana, for many courtesies and information; to Messrs. Chas. Beantley and H. O. Neville, of the Havana branch of the Chile Nitrate Committee, for some photographs and valuable criticisms; and to Dr. Mario Calvino, director of the Estación Experimental Agronómica at Santiago de las Vegas, for some photographs and valuable advice.

A typical cuban tobacco curing barn

EXPERIMENTAL MILLING TESTS OF ADLAY

By JAMES F. HAYES, *Milling Technologist, Milling Investigations, Bureau of Markets and Crop Estimates, United States Department of Agriculture*

The following is a description of the methods employed in the milling of the adlay grain submitted to this project for experimental milling and baking purposes and the experimental results obtained, together with suggestions regarding machinery equipment suitable for the commercial milling of adlay.

The adlay grain was first milled (Experiment No. 1) in the same manner as a sample of wheat, except that before milling, the adlay was run through a small single runner attrition mill for the purpose of hulling it. This operation was performed without breaking the kernel to any appreciable extent.

The material from this machine containing both the hulls and the kernels of adlay were then put through an experimental receiving separator, a picture of which is shown in Plate XIII. This machine extracted practically all the hull, chaff, and light material from the kernels. One of the distinctive features of this machine is that it has an adjustable air blast which can be regulated to any strength desired. The light material removed by this air blast is blown out into a settling chamber or dust collector.

A small experimental scourer of similar type to commercial scourers was used to further clean and polish the grain. A picture of this scourer is shown in Plate XIII. The adlay kernel being quite different from a wheat kernel, the scouring action broke the grain considerably and there was a larger loss from small particles being drawn out by the air blast than occurs in the case of wheat.

The grain was then milled on the experimental flour mill. The system used consisted of five breaks and three smooth roll operations. A flow sheet and a picture of the mill are presented herewith in Plate XIV and fig. 2, respectively.

After each reduction by the rolls the stock was graded in the sifter, which is a rectangular box-shaped machine containing five sieves of different degrees of fineness. The lower four sieves, clothed with 10 XX silk, No. 70 grits gauze, No. 50 grits gauze, and No. 30 grits gauze, respectively, remained fixed during

the break roll operations. The top, or fifth sieve, clothed with wire for scalping off coarse material, was changed after each break roll operation.

Adlay proved to be of very hard texture and in milling produced very sharp, dirty middlings. The break flour produced was small in amount and was badly contaminated with particles of the red skin coating the kernel.

The first smooth roll reduction of the middlings gave good results but very little flour was produced. The second smooth roll reduction showed a little flaking of the middlings but produced a fair amount of flour. The third smooth roll reduction gave such flakiness to the stock that only a small amount of flour was sifted out.

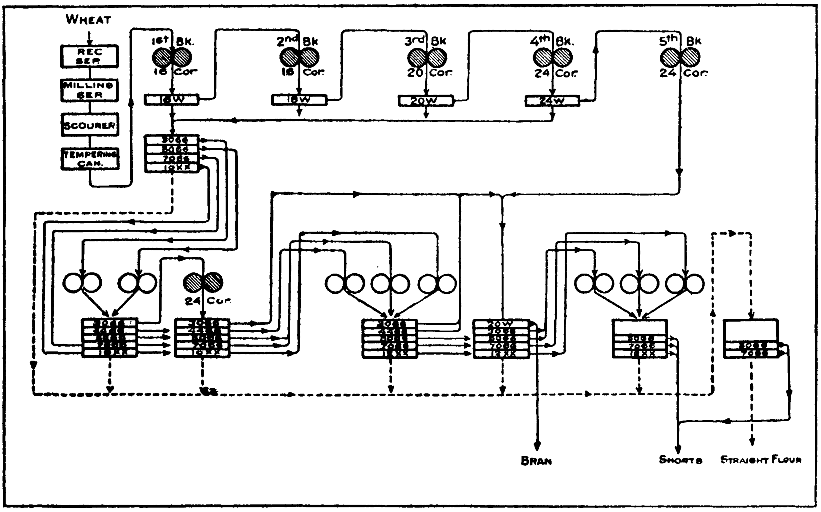
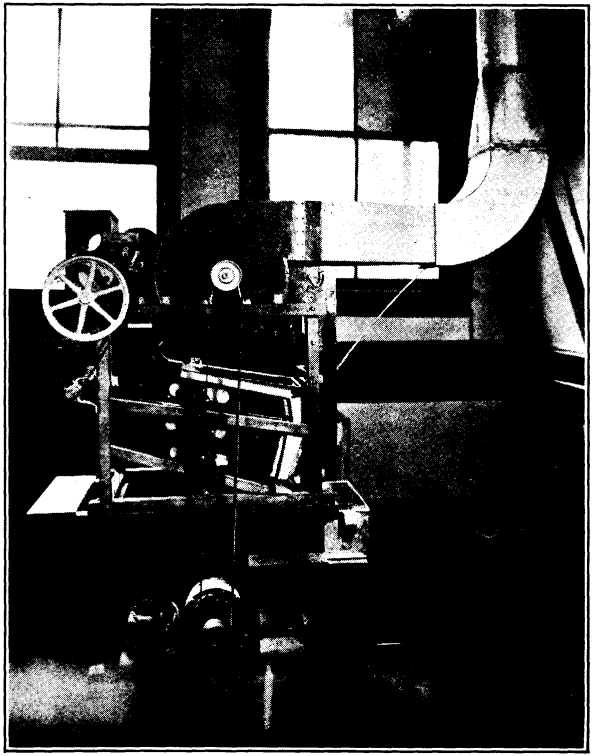


FIG. 2. Flow sheet of experimental mill.

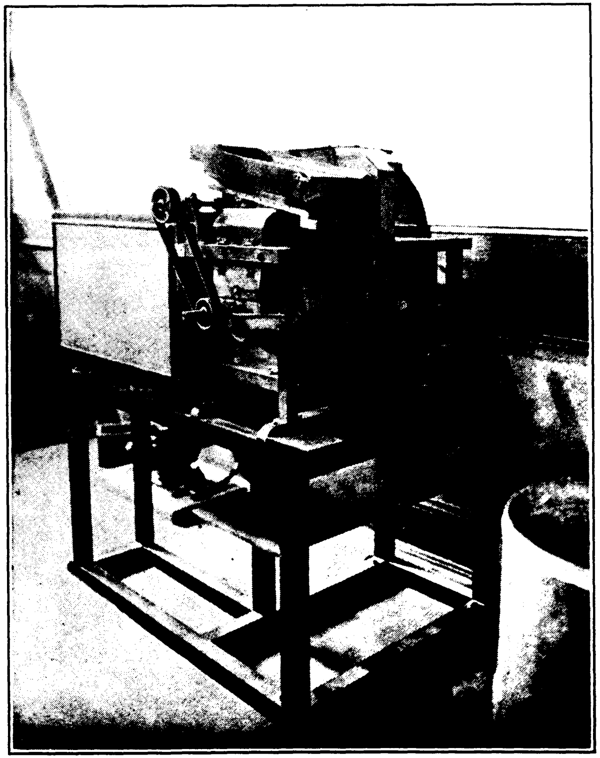
Although the object in this experiment was to obtain white flour, the flour produced was very specky in comparison with wheat flour and had an unusually dry and gritty feel. The specks were chiefly particles of the thin red skin coating of the kernel. The shorts seemed almost as fine as the flour but had a greasy feel.

In the second experiment of milling adlay, the object was to get as large an amount of flour as possible, color and clearness being only of secondary importance. The grain was hulled and cleaned in the same manner as in the first experiment but was not scoured. The kernels were ground through three breaks of the experimental mill. The grinding of the middlings produced on the breaks was done on a pair of special rolls with 40 corrugations to the inch. Three reductions of middlings were

Heads of one of the best forms of adlay from Bukidnon, Mindanao



(*a*) Experimental receiving separator



(*b*) Experimental scourer

made on these rolls and apparently with good result except that there was produced only a small quantity of flour fine enough to sift through a 10 XX silk sieve. Upon changing the flour sieve to an 8 XX silk, the flour thus obtained amounted to 63.7 per cent of the weight of grain after hulling. Later a No. 60 grits gauze sieve was tried and gave a 90 per cent yield of flour. The flour thus produced was very specky, like graham, was granular and had a slippery or greasy feel.

The third experiment was made with the object of producing graham flour from the whole kernel. The adlay was hulled and cleaned as in the previous experiments but not scoured. The hulled kernels were then ground on the single runner attrition mill adjusted for very fine grinding. The resulting material was sent through the rolls having 24 corrugations per inch, and finally through the rolls having 40 corrugations per inch. In this manner the middlings were very finely pulverized but the graham flour produced had a distinctly sandy feel.

Results obtained from experimental milling tests on adlay

Experiment	Hulls, chaff and light material extracted	Cleaned kernels	Milling yields from cleaned kernels				Remarks
			Flour	Shorts	Branny material	Milling loss	
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	
No. 1	47.0	53.0	48.0	46.0	2.0	2.0	Flour sifted through 10 XX silk. Flour white but specky.
No. 2	49.0	51.0	([a])63.7	32.4	2.5	1.4	([a]) Flour sifted through 8 XX silk.
			([b])90.0		8.5	1.5	([b]) Flour sifted through No. 60 grits gauze.
No. 3	43.0	57.0	99.0			1.0	Whole kernel graham flour.

MACHINERY SUGGESTED FOR THE COMMERCIAL MILLING OF ADLAY

The following suggestions are made concerning machinery suitable for the commercial milling of adlay grain into adlay graham flour:

1 Single shoe receiving separator. (Plate XV–*a*.)
1 Single runner attrition mill with special hulling plates.
1 Single shoe milling separator.
1 Double runner attrition mill with fine feed grinding plates. (Plate XV–*b*.)
1 Middlings mill.
1 Corn meal bolter and purifier.

These machines are adapted for grinding both adlay and corn into flour, meal, and breakfast food. A change from one grain to the other could be made very easily. This equipment also would be useful for cracking corn and grinding feed.

Preparatory to milling the grain both the coarse and fine foreign material present must be removed, consequently some kind of cleaning machinery is essential. A single shoe receiving separator will answer this purpose and will remove all sticks, straws, strings, fine seeds, and other impurities which may be in the grain when received at the mill. This type of machine is shown in Plate XV (*a*).

For breaking the hull and tearing it from the kernel, also in cracking corn, and grinding meal, the single runner attrition mill is very good. Special plates can be obtained for hulling seeds. The plates will wear well, are renewable at small expense, and are easily changed. Hulling is accomplished with very little broken grain. A machine with 18-inch grinding discs should hull from 50 to 100 bushels per hour.

The single shoe milling separator is suitable for extracting the hulls, light and fine particles from the kernels. This machine has an adjustable air suction and is made in almost any capacity desired.

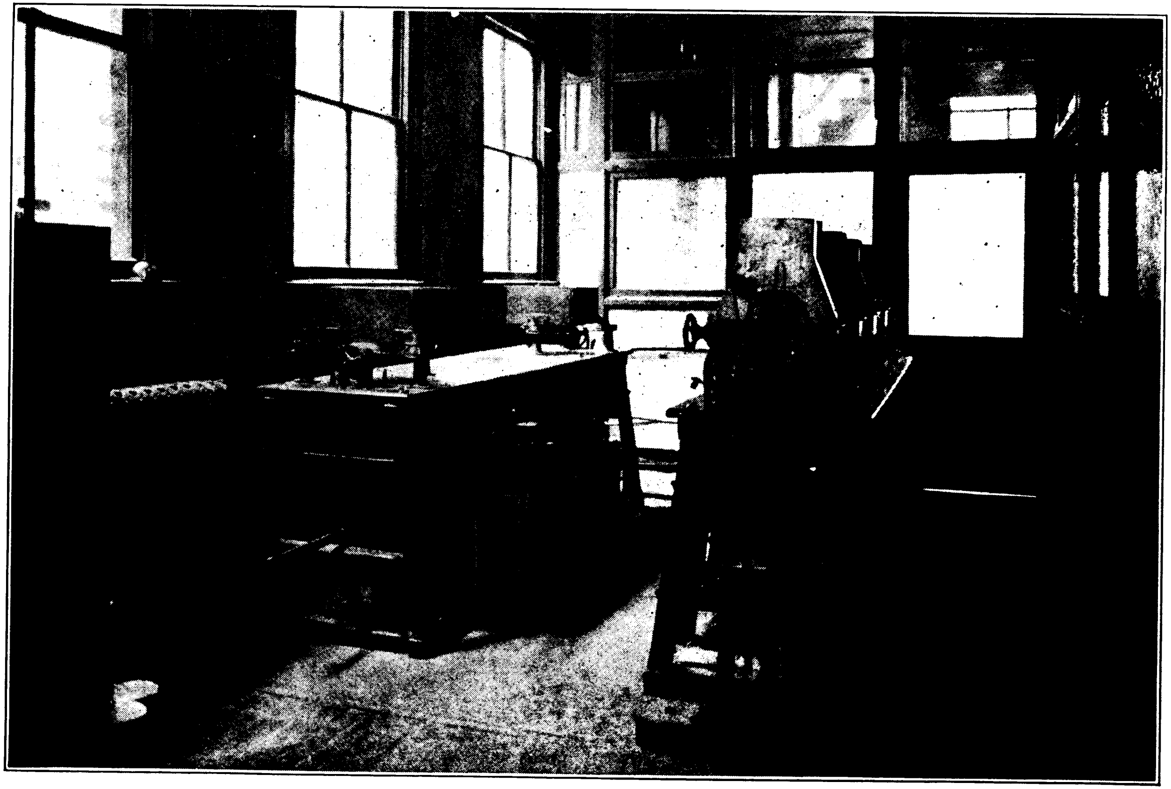
The double runner attrition mill shown in Plate XV (*b*) with 18-inch discs will reduce the clean kernels to fine middlings in a quick and efficient way. The two discs revolve in opposite directions at an approximate speed of 2,000 revolutions per minute. The capacity is from 1,500 to 3,000 pounds (880 to 1,760 kilos) per hour. The machine can be adjusted to grind to different degrees of fineness while in operation. The plates are renewable at small expense and easily changed.

The corn meal bolter and purifier is a combination sifter and purifier. The sieves can be changed easily and several separations made at one time. This machine, clothed properly, would take out the flour and return the coarser material to the double runner attrition mill or the middlings mill for regrinding. It is one of the most satisfactory corn meal bolters made.

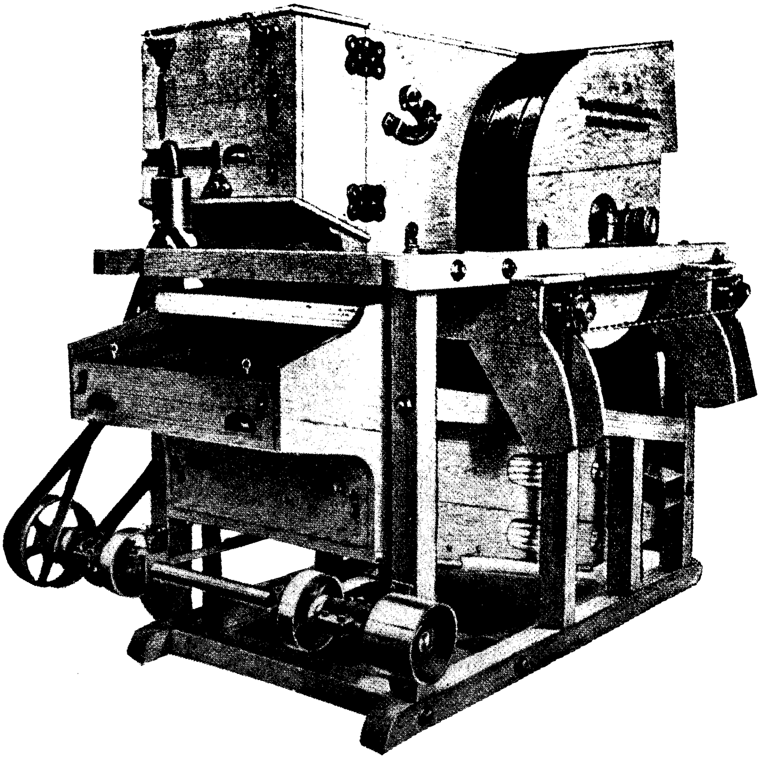
The middlings mill may be used to regrind the coarse material of good quality separated from the stock coming from the double runner attrition mill. After this material is ground it should be returned to the corn meal bolter for separation.

To operate these machines for automatic and continuous operation it would be necessary to have shafting, pulleys, belts, motor power, elevators, conveyors, bins, small packer, etc., finished lumber for spouting, and elevator casings and bins.

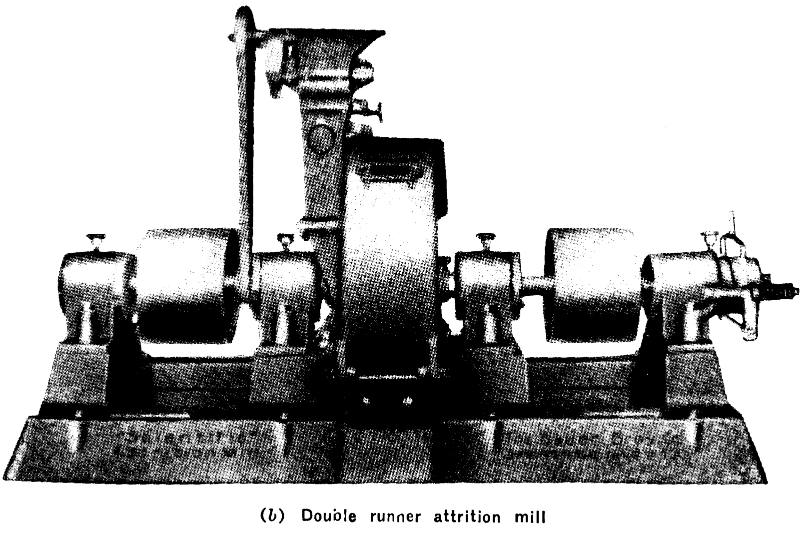
With the equipment described in the preceding paragraphs properly installed and operated by an intelligent miller of broad experience a very satisfactory graham and white flour may be milled from adlay.



Experimental mill



(*a*) Receiving separator



(*b*) Double runner attrition mill

EXPERIMENTAL BAKING TESTS OF FLOUR MADE OF ADLAY

By WALTER K. MARSHALL, *Acting in Charge, Milling Investigations, Bureau of Markets and Crop Estimates, United States Department of Agriculture*

Baking tests were made on three grades of flour mixed with certain percentages of commercial wheat flour by the baking laboratory of the Office of Milling Investigations, Bureau of Markets and Crop Estimates, United States Department of Agriculture.

The three grades of flour used for the tests were small amounts of a forty per cent extraction of the adlay grain, a sixty per cent extraction, and a graham flour consisting of the entire grain ground into flour after the outside hull was removed.

A few preliminary baking tests were made with variations in method and ingredients with each of the three grades of flour submitted, with a view to determine the best method of procedure to follow in order that the best possible loaf from the adlay and wheat flour mixtures might be secured.

The flour produced from adlay has an odor resembling that of fish and oysters, and this odor is retained in the bread in all of the admixtures made.

The following formula was found to give the best results, with slight variations in the amount of sugar and water for the greater percentages of adlay flour.

FORMULA

Flour	grams	340
Salt	do	5
Brown sugar (for 33⅓ and 50 per cent adlay mixture)	do	25
Brown sugar (for 66⅔ per cent adlay mixture)	do	30
Yeast (compressed)	do	10
Milk (scalded)	cubic centimeters	150
Water (for 33⅓ per cent adlay mixture)	do	76
Water (for 50 per cent adlay mixture)	do	80
Water (for 66⅔ per cent adlay mixture)	do	91
Shortening	grams	8

It was found that by scalding the adlay flour, adding whole milk and more than the average amount of sugar, there was a tendency to decrease the peculiar foreign taste and odor of the bread containing part adlay flour. However, there was not enough of the flour to conclusively test out the effect of the scalding process and as the milk and sugar seemed to mask the

odor and taste to a certain degree the scalding process was omitted in the following mixtures of adlay flour with wheat flour from which loaves shown in the accompanying photographs were made.

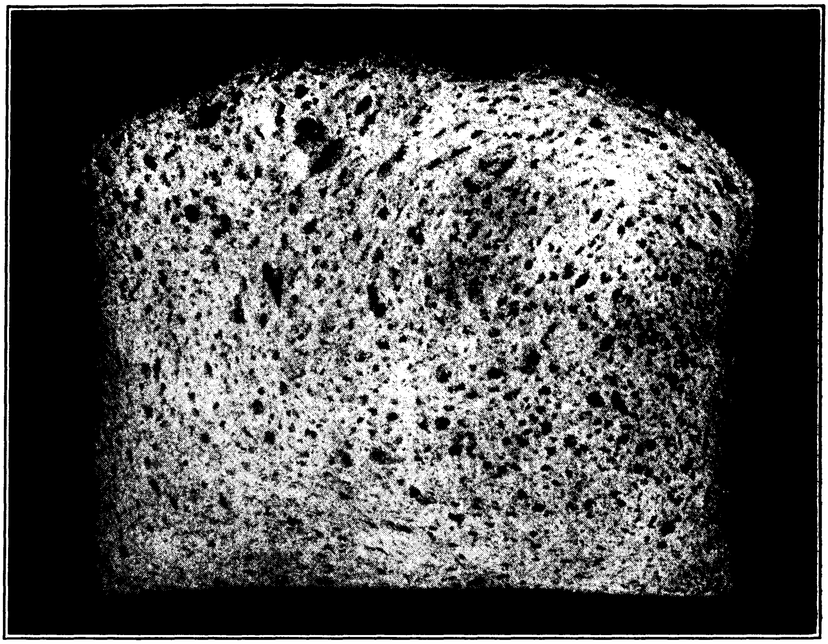
Plate XVI (*a*) shows a photograph of $66\frac{2}{3}$ per cent of the 40 per cent extraction of adlay flour with $33\frac{1}{3}$ per cent of commercial hard wheat flour. The volume of this loaf was 1,330 cubic centimeters and for the corresponding loaf in which the 60 per cent extraction flour was used the loaf volume was 1,280 cubic centimeters. The texture in both samples was very poor, the crumb being coarse in texture, with no resiliency when pressure was applied and released with the fingers.

Plate XVI (*b*) shows $33\frac{1}{3}$ per cent each of adlay flour (40 per cent extraction), commercial hard wheat flour, and Durum (macaroni) wheat graham flour. The volume of this loaf was slightly higher than that shown in figure 1, but the texture of the loaf was good. The color of the loaf was quite similar to wheat bread produced from a 50 per cent graham and straight flour mixture and the taste and odor of adlay was not especially pronounced.

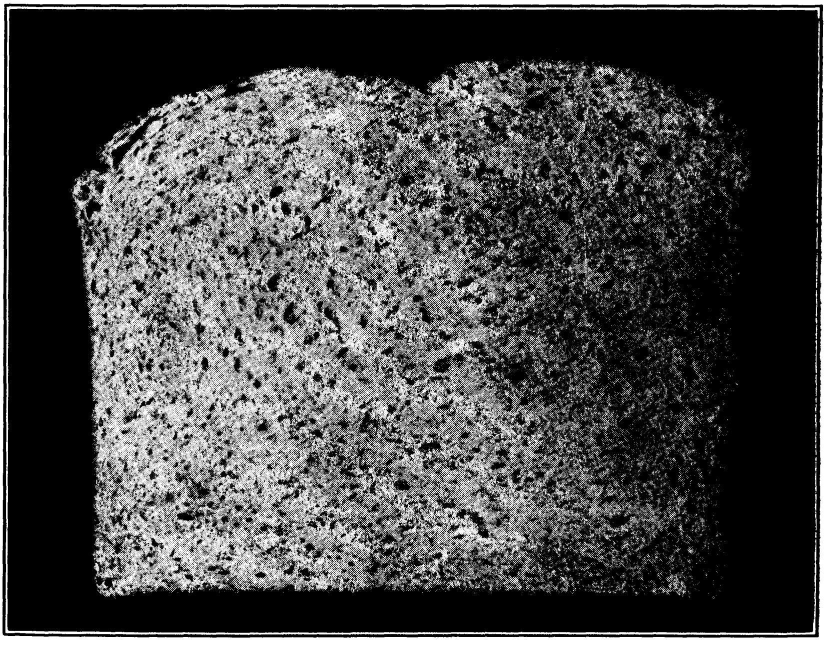
In Plate XVII is shown a loaf of 100 per cent commercial blended flour for comparison with loaf "A" in Plate XVIII. The other two loaves in this photograph represent a $33\frac{1}{3}$ per cent and a 50 per cent mixture of adlay flour (graham) with the commercial hard wheat flour. The middle loaf was the best made from all of the adlay mixtures. It was very similar in texture to the loaf shown in Plate XVI (*b*) but the volume was 430 cubic centimeters larger. Although the color and taste of the bread was foreign to that of any bread found in the American market it was quite palatable to those who tasted it.

The right end loaf in Plate XVII, a 50 per cent admixture of adlay graham flour and commercial hard wheat flour was of the same proportionate mixture as loaf "B" in Plate XVIII, but was baked in a smaller sized pan to determine the effect, if any, upon the volume and texture of the loaf. The baking results were practically the same for both loaves.

Plate XVIII shows a direct comparison between a loaf from 100 per cent of the wheat flour used in the adlay mixtures, shown as loaf "A," and this same flour mixed with the 50 per cent adlay graham shown as loaf "B," and with the $66\frac{2}{3}$ per cent adlay graham shown as loaf "C." The middle loaf in Plate XVII represents a mixture of $33\frac{1}{3}$ per cent of adlay graham flour with $66\frac{2}{3}$ per cent of the same wheat flour as used in the above mixtures.



(*a*) Admixture of 66⅔ per cent adlay flour (40 per cent extraction) and 33⅓ per cent commercial hard wheat flour—loaf volume, 1,330 cubic centimeters



(*b*) Admixture of 33⅓ per cent adlay flour (40 per cent extraction), 33⅓ per cent commercial hard wheat flour, and 33⅓ per cent durum (Macaroni) wheat flour (Graham)—loaf volume, 1,420 cubic centimeters

It will be noticed that the loaf volume of 2,570 cubic centimeters for loaf "A" made from the commercial hard wheat flour is considerably larger than the left end loaf of Plate XVII with only 1,970 cubic centimeters which was made from a commercial blended flour most of which was ground from a soft winter wheat.

Bread made from admixtures of adlay seed flour and wheat flour

Flour mixture	Extraction of adlay flour	Water absorption of flour[a]	Loaf volume	Shade of color of bread	Texture of bread
		Per cent	*c. c.*		
100 per cent commercial hard wheat flour.	....	60.3	2,570	Creamy gray.	Very good.
100 per cent commercial blended flour.	....	52.9	1,970	Creamy gray.	Very good.
$\frac{2}{3}$ adlay flour; $\frac{1}{3}$ commercial hard wheat flour	40 per cent extraction.	76.4	1,330	Dull gray.	Very poor.
$\frac{1}{3}$ adlay flour; $\frac{1}{3}$ commercial hard wheat flour; $\frac{1}{3}$ durum wheat flour (Graham)	40 per cent extraction.	72.1	1,420	Light brown.	Good.
$\frac{2}{3}$ adlay flour; $\frac{1}{3}$ commercial hard flour	Graham...	70.9	1,160	Brown...	Very poor.
$\frac{1}{3}$ adlay flour; $\frac{1}{2}$ commercial hard wheat flour	Graham...	70.6	1,460	Brown...	Fair.
$\frac{1}{3}$ adlay flour; $\frac{2}{3}$ commercial hard wheat flour	Graham...	64.7	1,850	Light brown.	Good.

[a] 44.1 per cent of which was milk.

It will be seen from the baking formula and the accompanying table that the larger percentages of adlay flour required more water in making up the dough.

The loaves of bread shown in the accompanying photographs were baked by the sponge dough method, given from forty to sixty minutes and fermentation in the pan and baked in an electric oven at 240° C. for forty minutes. The total time of fermentation from the time the sponge was made until the dough was panned was two hours and thirty-five minutes.

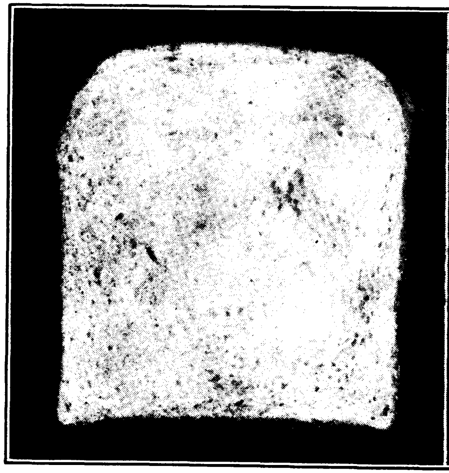
The color of the adlay flour was a dull gray in the sample of flour representing a 40 per cent extraction of the seed. This grayness was more pronounced in the 60 per cent extraction which contained many small specks. The graham sample of adlay flour containing all of the bran layer was considerably darker than the 60 per cent extraction. This difference in coloration of the flour samples existed also in the bread, the 40 per cent producing the best color of crumb, the 60 per cent next which was followed by the much darker gray and brown color of the graham loaf.

Although the amount of experimentation in this laboratory with the adlay seed flour as a partial substitute for wheat flour was very limited I think it fair to conclude that adlay cannot be substituted for wheat when it is to be ground into flour for bread-making purposes to compete with the average type of

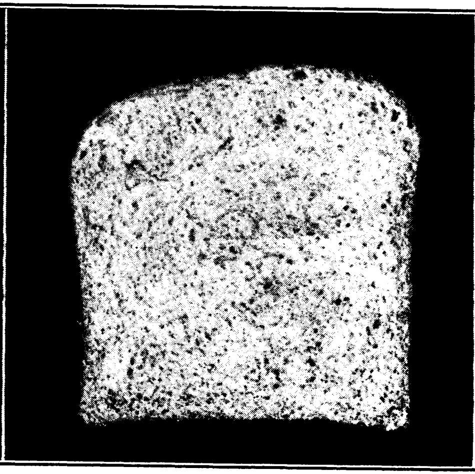
white or graham bread as sold in the markets of the United States. If the baking laboratory had been furnished with a larger amount of flour which could have been used for testing out the various baking methods and ingredients, a better loaf from a mixture of adlay flour and wheat flour might have been obtained.

Although no tests of this nature were made with the adlay flour by us, it is our opinion that a better use of adlay flour may possibly lie in its being mixed in the proper proportion with wheat flour in the manufacture of such products as breakfast food, griddle cakes, hot breads, and pastries that call for baking soda, or considerable sweetening or spice which are required to mask the foreign odor and taste present when made into the ordinary type of yeast leavened bread.

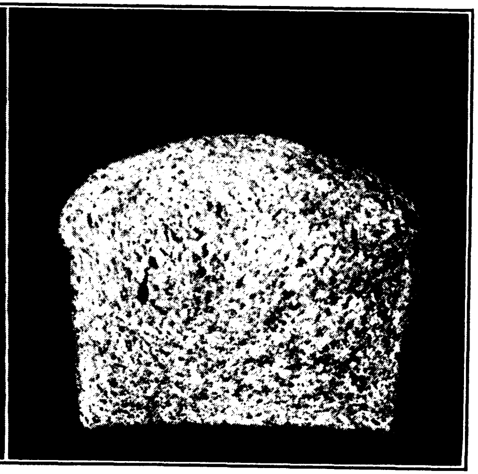
PLATE XVII



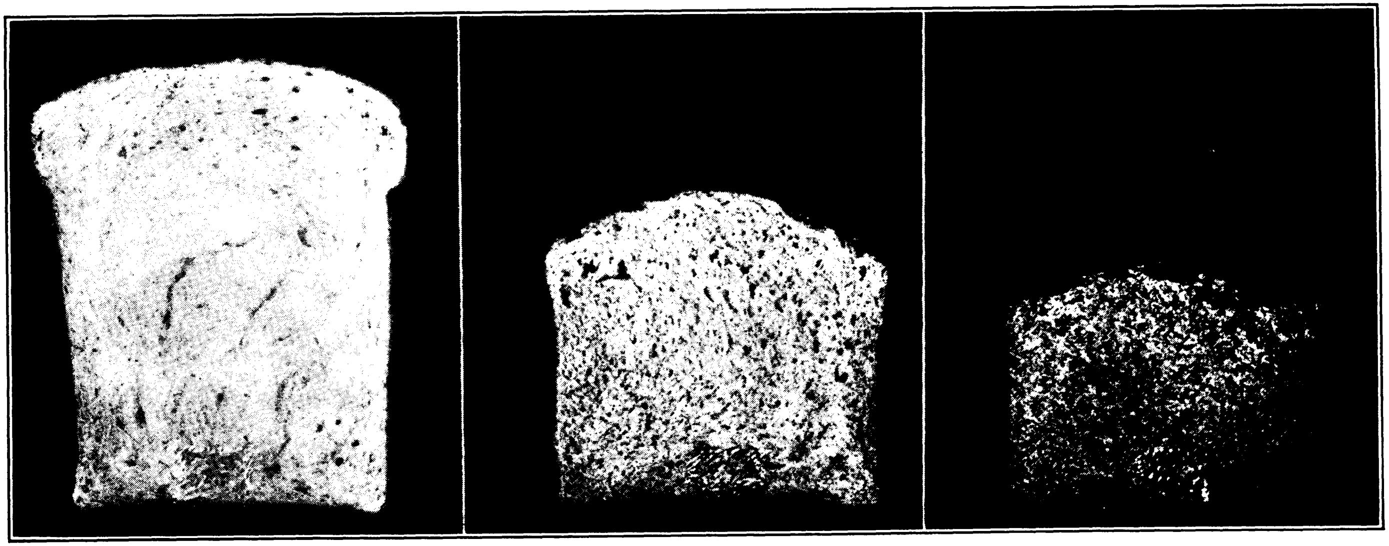
Admixture of 100 per cent commercial blended flour—loaf volume, 1,970 cubic centimeters



Admixture of 33⅓ per cent adlay flour (Graham) and 66⅔ per cent commercial hard wheat flour—loaf volume, 1,850 cubic centimeters



Admixture of 50 per cent adlay flour (Graham) and 50 per cent commercial hard wheat flour—loaf volume, 1,490 cubic centimeters



Loaf A.—100 per cent commercial hard wheat flour which was used in loaves B and C—loaf volume, 2,570 cubic centimeters

Loaf B.—admixture of 50 per cent adlay flour (Graham) and 50 per cent commercial hard wheat flour—loaf volume, 1,460 cubic centimeters

Loaf C.—admixture of 66⅔ per cent adlay flour (Graham) and 33⅓ per cent commercial hard wheat flour—loaf volume, 1,160 cubic centimeters;

DEMONSTRATION SHOWING THE BAKING QUALITIES OF ADLAY FLOUR, IN BATTERS AND DOUGHS OTHER THAN YEAST BREAD [1]

By MINNA C. DENTON and ELSBETH HOFFMAN, *Office of Home Economics, United States Department of Agriculture*

Two kinds of adlay flour have been sent recently to the Experimental Kitchen to be tested in general baking. One of these is an entire-grain flour, about 99 per cent extraction, only the hull being rejected; the other a more highly milled, whiter, finer flour, about 60 per cent extraction. Both samples seemed a little musty, probably from long storage; though a short heating period in a warm oven improved their flavor perceptibly. Both of these adlay flours have some of the characteristics of corn meal, e. g., a mealy, granular feel in the mouth; but they have, of course, a distinctive flavor, which proved especially attractive (so far as these experiments are concerned) when the whole grain was used, rather than the white flour. It may be added, that this whole or graham adlay flour, or meal, which was furnished us, was finely ground and so well sifted that it easily passed through an ordinary household flour sifter without loss of bran.

It has been observed upon many occasions in this laboratory (as doubtless also in other laboratories), that breads made without eggs, in which 20 to 50 per cent of the wheat flour is substituted by flours or meals lacking in gluten, are greatly improved in most respects if the dough contain a certain percentage of cooked starch, in the form of cooked flour or starch paste or cooked potato or cooked cereal. This more or less tenacious starch paste is of some assistance to the diluted wheat gluten, as a binding agent to help in retaining the leavening gases and steam. It has accordingly been our custom to "scald" or hydrate corn flour when making yeast bread, or baking powder biscuit with 25 per cent corn-flour and 75 per cent wheat-flour. The same practice apparently works very well with adlay flour, when the finer whiter flour is used; it is true both of yeast bread and of baking powder biscuits that color, texture, and flavor

[1] This article was prepared and distributed to those present at the adlay demonstration luncheon referred to on page 213, this REVIEW.—ED.

were improved by this practice. In case of the coarser and darker adlay flour, however, this device proved unnecessary, since such products were compared with graham rather than with white flour products.

In line with this observation as to the need for a considerable degree of hydration in such meals as corn flour and adlay flour, is the further observation that they can hardly be used to make a biscuit dough which is stiff enough to roll and cut. Such biscuits are dry, cracked, solid, and mealy, reminding one of yeast cakes in color, texture, and feel on the tongue. The softer batter known as "drop biscuit" or "emergency biscuit," on the other hand, can be successfully made, especially with scalding of all or a part of the flour or meal.

We learned during the war that the addition of eggs to "substitute" flours greatly improved their baking qualities. In fact, the old-fashioned "sponge cake" recipe which calls for one-half pint cup of eggs, 1 cup of flour, and 1 cup of sugar, may result successfully even with potato starch, sweet potato flour, and like products, when not a particle of wheat or rye gluten is present. We have no doubt that this relatively expensive product could easily be made from 100 per cent adlay flour with good satisfaction so far as texture is concerned. Of more importance is the observation that such products as muffins and simple cakes which contain a relatively small proportion of egg, may be successfully made from unscalded white adlay flour.

Pastry represents a distinctly different problem from that presented by other doughs and batters. The amount of water present in good pastry is very small, and the "development of gluten" is particularly undesirable. Our experience is, that white adlay flour, like corn flour, may be used up to about 33⅓ per cent of the entire amount of flour present; above that amount it imparts an undesirable mealy texture. Adlay flour (again, one cannot refrain from commenting, "like corn flour") makes a hard, over crisp cracker-like crust, unless a pastry formula high in fat be used. We should hardly have anticipated this result, knowing that adlay flour contains considerably more fat than does wheat flour. It would seem that the physical condition of the flour colloids is of more importance in pastry-making than are such variations in chemical composition.

The "cup" measure referred to below, is the half-pint cup containing about 240 grams of water. All measurements are level.

We regret very sincerely that illness of some of our staff and a number of recent changes in our force, together with unusual

press of other work, has made it impossible for us to demonstrate (at this luncheon) all of the receipes which we have developed for the use of this flour. However, we are glad to vouch for the general excellence of the products described in the recipes given.

DROP BISCUITS

50 per cent white adlay flour, 50 per cent white wheat flour

½ cup white adlay flour (60 grams or about 2 ounces)
½ cup white wheat flour (60 grams or about 2 ounces)
2 teaspoons baking powder (7 grams or ¼ ounce)
¼ teaspoon salt (1.5 grams or 1/20 ounce)
4⅝ tablespoons milk (75 grams or about 2⅝ ounces) for scalding adlay flour
About 5 tablespoons milk (80 grams or nearly 3 ounces) for mixing batter
2 tablespoons fat (28 grams or 1 ounce)

Scald adlay flour with half of the milk, let stand until cool. Sift baking powder and salt with wheat flour, and cut the fat in with a knife or biscuit cutter. Add scalded adlay flour, and last of all sufficient milk to make a very soft drop batter. Drop by spoonfuls onto baking sheet. Bake in hot oven (450° to 475° F.) for 11 to 14 minutes, or until they begin to brown.

The advantage in scalding the white adlay flour is twofold; first, the characteristic flavor of the white adlay flour, which is not altogether pleasant, is made much milder; second, the texture is greatly improved by this preliminary hydration of the starch; the gluten has a better chance to imbibe its share of the moisture, therefore it can act as a binder and retain the leavening gas. Consequently the resulting product seems much more like an all-wheat biscuit, i. e., much less mealy and granular, and much more porous, than when an unscalded meal is used.

DROP BISCUITS

50 per cent entire-grain adlay flour, 50 per cent white wheat flour

½ cup entire grain adlay flour (60 grams or about 2 ounces)
½ cup white wheat flour (60 grams or about 2 ounces)
2 teaspoons baking powder (7 grams or ¼ ounce)
¼ teaspoon salt (1.5 grams or 1/20 ounce)
7 tablespoons milk (105 grams or 3¾ ounces, a little less than ½ cup)
2 tablespoons fat (28 grams or 1 ounce)

Mix the 2 kinds of flour well together, sift with baking powder and salt. Cut in fat with knife or biscuit cutter, then add the milk gradually to make a soft batter. Drop by spoonfuls onto a baking sheet. Bake in hot oven (450° to 475° F.) for 12 to 15 minutes.

It is quite possible to make fairly good drop biscuits by combining equal parts of entire grain adlay flour with graham, or entire grain wheat flour; or equal parts of white adlay flour and entire-grain wheat flour. However, in these experiments, the flavor of the entire-grain adlay flour was preferred to that of the white adlay flour; and the texture is of course better when white wheat flour is present, because of the superior quality of its gluten for baking purposes.

ADLAY MUFFINS

33 per cent entire-grain adlay, 67 per cent white wheat flour

⅔ cup entire grain adlay flour (75 grams or 2⅔ ounces)
1⅓ cups white wheat flour (150 grams or 5¼ ounces)
3 teaspoons baking powder (11 grams or about ⅜ ounce)
¼ teaspoon salt (1.5 grams or 1/20 ounce)
⅛ cup sugar (25 grams or nearly 1 ounce)
1 egg (50 grams or nearly 2 ounces)
1 cup milk (245 grams or about 8½ ounces)
¼ cup butter (56 grams or 2 ounces)

Cream the butter with a spoon until smooth and soft, add sugar and egg well beaten, and cream those together. Sift both flours, baking powder and salt together. Then add dry ingredients to first mixture, a few spoonfuls at a time, alternately with a few spoonfuls of the milk, meanwhile mixing as lightly as possible until the batter is smooth. Allow dough to stand 5 to 8 minutes before baking, since it absorbs excess moisture and thickens on standing. Bake in oiled muffin tins in a moderately hot oven (375° to 415°F.) for 25 minutes. This recipe makes 12 muffins of about 1½ ounces each.

ORANGE DROP CAKES

33 per cent entire-grain adlay flour, 67 per cent wheat flour

⅓ cup entire-grain adlay flour (37 grams or 1⅓ ounces)
⅔ cup white wheat flour (75 grams or nearly 2¾ ounces)
2 teaspoons baking powder (7 grams or ¼ ounce)
½ teaspoon salt (3 grams or about 1/10 ounce)
½ cup sugar (100 grams or 3½ ounces)
1 egg (50 grams or nearly 2 ounces)
1 tablespoon grated orange rind (about 7 grams or ¼ ounce)
2 tablespoons orange juice (30 grams or about 1 ounce)
2 tablespoons butter (28 grams or 1 ounce)

Cream butter with spoon until smooth, add sugar, orange juice, and rind and well beaten egg; cream well together. Add to the first mixture, the flour which has been sifted with salt and baking powder; beat well together. Drop on baking tin by spoonfuls, allowing plenty of room for cookie to spread as it

bakes. Bake in moderately hot oven (375° to 400°F.) for 5 to 10 minutes, or until slightly browned.

SCOTCH SHORT CAKES

50 per cent white adlay flour, 50 per cent white wheat flour

½ cup white adlay flour (56 grams or 2 ounces)
½ cup white wheat flour (56 grams or 2 ounces)
6 tablespoons sugar (84 grams or 3 ounces)
1 egg (50 grams or nearly 2 ounces)
4½ tablespoons butter (62 grams or about 2¼ ounces)

Mix flour and butter by rubbing between fingers or by cutting finely with biscuit cutter; then add the sugar, mixing well with spoon; then egg well beaten, and mix again until all ingredients are thoroughly blended together. Turn the dough into a shallow square cake pan, pat into a flat sheet. Bake in a slow oven (300° to 325° F.) until light brown in color, or for about 35 minutes. Mark the dough into squares of suitable size (about 1½ inches) with a knife, 20 minutes before taking from the oven.

ADLAY TEA CAKES

50 per cent white adlay flour, 50 per cent white wheat flour

½ cup white adlay flour (59 grams or about 2 ounces)
½ cup white wheat flour (59 grams or about 2 ounces)
1 teaspoon baking powder (3.5 grams or about ⅛ ounce)
⅔ cup sugar (135 grams or nearly 5 ounces)
1 egg (50 grams or nearly 2 ounces)
6 tablespoons milk (90 grams or nearly 3¼ ounces)
1 teaspoon vanilla extract or other flavoring as desired (5 grams or almost ⅛ ounce)
⅓ cup butter (75 grams or nearly 2¾ ounces)

Cream butter with spoon until smooth. Add sugar gradually, stirring or beating constantly. Add egg well beaten and milk. Sift baking powder with adlay and wheat flour. Combine dry and wet ingredients, mixing as lightly as possible. Do not stir unnecessarily. Bake in oiled muffin tins, for 15 to 20 minutes in moderately slow oven (350° F.).

ADLAY WAFERS

50 per cent entire-grain adlay, 50 per cent white wheat flour

½ cup entire-grain adlay flour (57 grams or 2 ounces)
½ cup white wheat flour (57 grams or 2 ounces)
¼ teaspoon soda (1 gram or 1/30 ounce)
½ teaspoon salt (3 grams or 1/10 ounce)
½ cup sugar (100 grams or 3½ ounces)
1 egg (50 grams or nearly 2 ounces)
⅛ cup sweet milk (30 grams or about 1 ounce)
1¼ cups rolled (ground) oats (140 grams or 5 ounces)
½ tablespoon molasses (about 10 grams or ⅓ ounce)
1 teaspoon cinnamon (3 grams or 1/10 ounce)
¼ cup butter (56 grams or 2 ounces)

Cream butter, add sugar, egg well beaten and molasses; beat well. Put rolled oats through the coffee-grinder twice, or through the meat grinder, using finest knife. Sift all dry ingredients together, add to the first mixture, stirring lightly. Allow dough to stand 15 to 20 minutes to thicken. Sift a little wheat flour on rolling board, turn out the dough and roll very thin. Cut into squares or wafers or other shapes. Place on baking sheet and bake about 10 minutes in moderately hot oven (400° F.).

ADLAY NUT BREAD

57 per cent entire-grain adlay flour, 43 per cent white wheat flour

1 cup adlay entire-grain flour (113 grams or 4 ounces)
¾ cup white wheat flour (85 grams or 3 ounces)
1 teaspoon baking powder (3½ grams or ⅛ ounce)
½ teaspoon soda (2 grams or 1/14 ounce)
½ teaspoon salt (3 grams or 1/10 ounce)
⅛ cup sugar (24 grams or 6/7 ounce)
½ cup nuts (42 grams or 1½ ounces)
1 egg (50 grams or nearly 2 ounces)
1 cup milk (245 grams or 8¾ ounces)

Sift the flours, baking powder, salt, soda, and sugar together. Add nuts (which have been chopped finely or coarsely as desired), milk, and egg well beaten, stirring lightly. Allow mixture to stand 10 minutes to thicken. Put into two oiled bread pans. Bake in a moderately slow oven (350° F.) for 15 minutes. increasing heat slightly (to 400° F.) for the remainder of the baking period. These small loaves will need to bake 40 to 60 minutes, in order to be thoroughly done.

ADLAY PASTRY

33 per cent white adlay flour, 67 per cent wheat flour

½ cup white adlay flour (56 grams or 2 ounces)
1 cup white wheat flour (112 grams or 4 ounces)
½ teaspoon salt (3 grams or 1/10 ounce)
6 tablespoons lard or lard substitute (84 grams or 3 ounces)
3 tablespoons water (42 grams or 1½ ounces)

Sift adlay flour, wheat flour, and salt together; cut in the fat with a biscuit cutter until thoroughly blended. Take out about ¼ of this mixture of flour and fat, reserving it to be used later on upper and under crusts. Add the water gradually to the remainder of the flour and fat; continue cutting with the biscuit cutter until the water is evenly distributed, and the dough forms a mass which can be turned out on the board. Divide the dough into 2 equal parts, 1 for each crust; pat each lightly

into a little flat cake about 5 inches square. Sprinkle half of the reserved flour-and-fat mixture on each cake, then fold the edges inward toward the center from all four sides, and roll into a square; fold twice to make a smaller square, and roll into shape to fit the pan. Put filling in place on lower crust, cover with perforated upper crust, pinching the edges of the two crusts together, and bake 25 to 35 minutes in hot oven.

The appearance of the upper crust is greatly improved when adlay flour is used, if a glaze be applied with a soft brush or with a bit of cotton or soft clean cloth, just before the pie is put in to bake. Sweet cream makes a good glaze; or a glaze may be made from 1 egg and one-half pint cupful of milk.

ADLAY COCONUT PUDDING (BICO)

1 cup white adlay flour (113 grams or 4 ounces)
½ cup sugar (100 grams or 3½ ounces)
1 cup coconut milk and 1 cup of freshly ground coconut (566 grams together, or 20 ounces)
1 teaspoon vanilla extract (5 grams or about ⅙ ounce)

Mix all ingredients together. Cook in double boiler or *bain-marie,* i. e., in a dish placed in or over boiling water, to prevent burning. Stir well occasionally until it has thickened. Cook for about 40 minutes.

Eat while warm, with cream or with any suitable pudding ounce.

ADDITIONAL NOTES ON ADLAY

By P. J. WESTER

Those of our readers who have followed the progress of the work with adlay (Plate XII) by this Bureau in previous issues of this REVIEW [1] may be interested in the later developments which, briefly, are as follows:

After the harvest of adlay at the close of 1921, grain was hulled and ground into flour on a coffee mill placed at our disposal by the Pacific Commercial Company, in Manila, a part of this being scoured on a rice huller with a view to producing a white flour. This latter process, by the way, was not very successful, in that too much of the kernel was wasted.

The flour, white and whole-adlay, obtained was then delivered to the Sanitary Bakery, Manila, for experimentation in making yeast leavened bread by Mr. Harry Schoenhout, who as he became familiar with the flour made both white and graham bread of good quality from mixtures of adlay and wheat flour containing from 50 to 66 per cent adlay flour, the graham bread being of especially good taste. To further acquaint the public with the new bread arrangements were now made with Mr. R. W. Berdeau, President of the Rotary Club, Manila, to serve the bread at a luncheon given at the Manila Hotel, February 9, 1922, where it was favorably commented upon by many of the 300 people present.

Lack of equipment had hitherto prevented experimentation with milling machinery to reduce the grain to flour, and to help us obtain data relative to this, Mr. Geo. L. Logan, District Manager of the United States Department of Commerce for Manila, kindly franked about 50 kilos of adlay to his Department in Washington, where it was placed at the disposal of the writer, who secured the coöperation of Mr. J. S. Schollenberger, in charge of the Milling Investigations of the Bureau of Markets, with the result that he made a series of milling experiments with the grain and baking tests of the flour; and of Dr. C. F. Langworthy, Chief of the Office of Home Economics, Bureau of Plant Industry, United States, Department of Agriculture, in whose office many experiments were made in using

[1] See Vol. XIII, p. 217, and XIV, pp. 159 and 168.

adlay as a wheat substitute in making biscuits, muffins, cakes, pies, etc., at the conclusion of which an adlay demonstration luncheon was served by Dr. Minna C. Denton, Assistant Chief of the Office of Home Economics, May 23.

At the conclusion of the luncheon those present were asked to express their opinion of the new foods, including yeast leavened breads, furnished by Mr. W. K. Marshall.

The following are sample quotations:

I tried risen bread, muffins, and pie crust containing adlay and found them very palatable.

W. H. Beal
On Editorial Staff
Experiment Station Records

The adlay products were very palatable and it would seem to me the grain offers great possibilities for the Tropics.

Walter H. Evans
Chief, Insular Stations

When used with wheat flour, half and half, I find the result is very good. Nobody should refuse to eat adlay, for its flavor is distinctive and I imagine one might grow as fond of it as one does of maize.

David Fairchild
Agricultural Explorer in Charge of
Foreign Seed and Plant Introduction

Adlay gives results—used with wheat flour—much like those obtained with kaffir corn. It is palatable and can be employed in cooking in a number of ways.

C. F. Langworthy
Chief, Office of Home Economics

The adlay products make a very favorable impression and compare with the pure wheat articles without disadvantage.

O. F. Cook
Bionimist in Charge
of Crop Acclimatization

The adlay products look very promising—especially when blended with wheat flour. The pastry in particular was delicious!

W. T. Swingle
Physiologist in Charge
of Physiology and Breeding Investigations

The adlay products tasted today are certainly very palatable and appeal to me as not inferior to those made of wheat.

G. N. Collins
Botanist, Bureau of Plant Industry

I sampled pie crust, bread, cookies, and cake made from adlay flour and found all of them very palatable and agreeable. I think there are great possibilities for adlay in sections that must import wheat flour.

L. H. Bailey
Assistant Chemist, Bureau of Chemistry

I had the pleasure of trying adlay in muffins and pie crust and found it very palatable.

HARRY CLEMONS
Professor, University of Nanking, China

Recipes for the different products served at the luncheon are given in a paper by Doctor Denton and Miss Hoffman published on another page of this REVIEW which was distributed to those present.

The reports on the milling and baking experiments made by the Bureau of Markets are also published in this issue of the REVIEW.

Commenting on the milling tests, which show a rather large amount of waste in hulling, it is believed that further experimentation would reduce this very considerably. While a white flour can be produced which can be used as a wheat flour substitute for bread and other culinary products, it appears that the waste in milling is so great as to make doubtful the value of its extensive employment for this purpose. And it is evident that the utility of adlay as a wheat bread substitute will be in the form of a "whole-adlay" or "graham-adlay" flour, especially as bread made from a mixture of whole adlay and wheat flour tastes better and has more of the peculiar flavor of adlay as distinct from that of wheat bread.

It is to be noted that as experience in milling the grain was gained the waste incident to the hulling process was reduced from 49 to 43 per cent. In as much as the analyses of adlay made by the Bureau of Science, quoted in a previous issue of this Review, have shown a recovery of kernels ranging from 69.92 to 76.6 per cent, in the best Bukidnon forms, it is believed that with more experience in milling the waste could be reduced to 40 per cent, possibly even to 35 per cent. In other words, milled with a recovery of 57 per cent one ton of adlay yields 564 kilos of whole-adlay flour. If the waste could be reduced to 40 per cent a ton of grain would yield 594 kilos of flour. If the waste could be reduced to 35 per cent the yield of flour would be 643 kilos of whole-adlay flour from each ton of milled grain.

The improvement in the quality of the bread in successive bakings as the requirements of the adlay flour became better known to the baker was quite evident, and was very interesting to watch. No less interesting was it to note the impression made by the adlay products on different palates. Bread was distributed to numerous people for sampling in comparison with wheat bread, many of whom expressed a preference for that made of adlay. Nearly all said they found little if any difference in eating quality between adlay and wheat bread and

that the adlay bread would sell in the market without difficulty on its own merits.

As an expression of this difference of opinion it is not without interest to quote from the report of the Milling Technologist, Acting In Charge:

"The flour produced from adlay seed has an odor resembling that of fish and oysters, and this odor is retained in the bread in all of the admixtures made."

See also the last paragraph in his report.

Doctor Denton and Miss Hoffmann in their paper state (speaking of adlay flour, white and graham, of the same lot of flours just commented upon) "They have * * * a distinctive flavor which proved especially attractive (so far as these experiments are concerned) when the whole grain was used, rather than the white flour."

After the harvest of adlay grown by coöperators who received seed from the Bureau in 1922, several reported themselves well satisfied with the yield but stated they hesitated to plant the grain on a large scale owing to a lack of market, there being no flour mills in the Philippines.

After the milling experiments in the Bureau of Markets had been concluded, the writer wrote to Sprout, Waldron & Co., manufactures of flour mills, for estimates of flour mills in the event that the Philippine Government would undertake the erection of mills, so as to create a market for the grain at the same time it introduced the flour among the public. The following extract is quoted from their reply:

We are enclosing blueprint as of date 8/22/22, also three flow sheets Nos. 1 and 2 of No. 2, showing proposed installation of the machines as outlined in your letter which, of course, is submitted subject to your approval or subject to changes that might be necessary to suit buildings erected for equipment of this kind. We beg to quote you as follows:

Estimate No. 1 [a]

1 No. 2 Monarch receiving separator style "D"	$252.00
1 16″ Monarch ball bearing single head mill [b]	342.00
1 No. 21 Monarch milling separator style "G"	183.26
1 16″ Monarch ball bearing attrition mill [c]	450.00
1 No. 1 Monarch ball bearing middlings mills	84.50
1 No. 2 Monarch middlings purifier	315.00
Total	1,626.76

[a] All figures noted in this and the following estimates are U. S. currency, $1=₱2 Philippine currency.

[b] Capacity 17.5 to 26.5 hectoliters per hour.

[c] Capacity 450 to 900 kilos per hour.

You will add the following to the above if you should consider it advisable to put in dust collector as outlined in flow sheet:

1 No. 10 Monarch deflecting dust collector for receiving separator	$168.00
1 No. 9 Monarch deflecting dust collector for milling separator	152.00
1 No. 7 Monarch deflecting dust collector of purifier	112.00
Total	432.00

The above prices on collectors do not include vents or piping from the machine to the collector and from the collector to the outside of the building.

Estimate No. 2

1 No. 2 Monarch receiving separator style "D"	$252.00
1 24″ Monarch single head mill [d]	477.00
1 No. 21 Monarch milling separator style "C"	183.26
1 20″ Monarch ball bearing attrition mill [e]	522.00
1 No. 5 Monarch ball bearing middlings mill	110.50
1 4-section 8″ Sieve Monarch ball bearing Self balancing sieve bolter, style "E"	814.00
Total	2,358.76

If you add dust collectors as shown in blueprint you will add the following to the above:

1 No. 10 Monarch deflecting dust collector for receiving separator	$168.00
1 No. 9 Monarch deflecting dust collector for milling separator	152.00
Total	320.00

Spouting to be furnished by you as in estimate No. 1.

In estimate No. 2, if you should decide not to use the four section 8″ sieve bolter, you can deduct the price quoted of $814.00 and add the following:

1 No. 2 Monarch middlings purifier	$315.00
and if dust collectors are required, add:	
1 No. 17 Monarch deflecting dust collector for purifier	112.00
Total	427.00

We estimate that the power connections such as shafting, pulleys, set collars, bearings, hangers, elevators, and belting, would cost approximately $863 and the power connections in both estimates No. 1 and 2 would be practically the same.

[d] Capacity 35 to 70 hectoliters per hour.

[e] Capacity 815 to 1,685 kilos per hour.

Totaling the above proposition, the same would stand about as follows:

Estimate No. 1

Machinery as specified	$1,626.76
If dust collectors are wanted add	432.00
If power connections are wanted add	863.00
Total	2,921.76

We estimate net weight, gross weight, and cubic feet as follows:

On machinery—

Net weight	5,245
Gross weight	7,610
Cubic feet	860

On item No. 2 of estimate No. 1, if dust collectors are included, add the following:

Net weight	2,080
Gross weight	5,046
Cubic feet	1,212

On estimate No. 1, item No. 3, if power connections are included, add the following:

Net weight	2,500
Gross weight	3,200
Cubic feet	300

Estimate No. 2

Machinery as specified	$2,358.76
If dust collectors are wanted add	320.00
If power connections are wanted add	875.00
Total	3,553.76

If purifiers and dust collectors are specified instead of sifter, deduct $405, from the total of $3,553.76.

We estimate the net weight, gross weight and cubic feet as follows:

On machinery as specified in estimate No. 2:

Net	6,965
Gross weight	10,050
Cubic feet	813

On item No. 2 of estimate No. 2, if dust collectors are included, add the following:

Net weight	1,590
Gross weight	3,802
Cubic feet	948

If power connections are included in item No. 3, estimate No. 2, add the following:

Net weight	2,500
Gross weight	3,200
Cubic feet	300

The above quotations are for the equipment boxed for ocean shipment and f. o. b. cars our factory. We have taken the matter up with our railroad connections and just as soon as we can obtain the present-day freight rate from Muncy to Manila, we will advise you so, that you can add what the present cost of delivery of same to Manila would be. The freight, of course, will be regulated at the time shipment is made as to the rate of freight that is in effect at that time.

In a subsequent letter the freight on the machinery from Muncy, Pa., the point of origin, to Manila, P. I., is quoted at $1,297.28.

In Estimate No. 2 provision has been made for a bolter, so white flour can be milled if desired.

Doctor Schollenberger called the writer's attention to the Arcade Home Flour Mill, as a cheap mill that might to advantage be introduced among the farmers who wish to mill their own grain. This mill combines simplicity of construction with economy. There are no complicated parts to get out of order, it is strongly made, and the price is very low. Nos. 1 and 2 may be turned by hand. No. 2 also has a pulley fly-wheel, so that it can be driven by a belt when it has a capacity of a bushel of grain per hour at 230 revolutions per minute. No. 3 is belt driven.

By properly adjusting the burrs, the Arcade mill can be used both to hull the grain and after the broken hulls have been removed to grind the kernels into flour or grits. And it can, of course, be used in grinding other grains into feed if desired.

It is a pleasure to acknowledge the indebtedness of this Bureau for the helpful interest shown in adlay by many of the officials in the United States Department of Agriculture, and especially for the coöperation of Doctor Langworthy and Doctor Denton of the Bureau of Plant Industry, and of Mr. Schollenberger, Mr. Marshall, and Mr. Hayes of the Bureau of Markets, through which our knowledge of the uses of the grain and its milling requirements has been greatly enlarged.

CALIFORNIA SCALY BARK AND BARK ROT OF CITRUS TREES IN THE PHILIPPINES

By H. ATHERTON LEE, *Formerly Mycologist, Bureau of Science*

INTRODUCTION

In the early days of American occupation of the Philippines there existed in Batangas Province, a considerable orange producing industry. Old residents speak of the time when oranges were shipped into Manila by the car load; Wester [1] in the Philippine Agricultural Review also describes this former prosperity of the citrus industry. The citrus fruits produced were for the most part seedling mandarin oranges, *Citrus nobilis* var *deliciosa,* and seedling sweet oranges, *Citrus sinensis.*

In the year 1911 occurred the eruption of Taal Volcano and the distribution of hot ashes throughout Batangas Province and even to some extent in Laguna, Rizal, and Cavite Provinces. At about the same time growers complained of their trees gradually beginning to die; this progressed gradually and was noted in publications by both Wester [1] and Zerbst.[2] At the present time the production of citrus fruits in Batangas Province is very much diminished and many previously prosperous orchards are entirely killed out or abandoned.

The growers for the most part have ascribed this dying of their orchards to the hot ashes distributed from the Taal Volcano in 1911; it is certain that the gradual dying became first noticed at about that time. The typical lesions accompanying the dying of the trees are found at the present time in Batangas, Laguna, Cavite, and Rizal Provinces on Luzon and on the Islands of Negros, Mindanao, and Basilan. The same lesions on citrus trees have also been observed by the writer in South China and Japan. It is obvious that since the distribution of hot ashes from Taal Volcano in 1911 did not reach Negros, Basilan, or Mindanao, or South China or Japan that the lesions which cause the death of the trees, do not arise from injuries from the hot

[1] WESTER, P. J. The situation in the citrus District of Batangas. Phil. Agr. Review, Vol. VI, No. 3 (1913), p. 125.

[2] ZERBST, G. H. Citrus barkrot. Philip. Agr. Review, Vol. VIII, No. 2 (1915), p. 95.

ashes. Moreover, trees planted since 1911, have in many cases become affected and succumbed. It must be evident to the citrus growers therefore that they are dealing with diseased conditions not due to mechanical injury from volcanic ashes. In the present paper a photographic study is presented which indicates that two distinct types of diseases are involved in this rapid killing out of the citrus trees in Batangas Province. The identity of one of these diseases is definitely pointed out altho it does not seem advisable to advance conclusions as to the identity of the other disease as yet.

PSOROSIS OR CALIFORNIA SCALY BARK UPON SWEET ORANGE TREES

Description.—The disease upon trees of the sweet orange (cajel), *Citrus sinensis,* is at first glance a pushing up of the outer bark, and drying and subsequent shedding of such bark such as shown in plates 1 and 2.

Closer examination shows that the first stage of the disease on the sweet orange is a proliferation of tissue which pushes the bark up, causing it to crack or peel entirely. This is shown clearly in plates 1, 2, and 3. The erupting tissue is usually from 3 mm. to 10 mm. in diameter but irregular in shap; it is of various shades of light green in color and usually of a mealy, amorphous texture. The area of the bark which is pushed out is of course larger, $\frac{1}{2}$ cm. and as much as 2 cm. from one eruption. A number of eruptions sometimes appear simultaneously, and have an appearance frequently of having been arranged in whorls. The area of bark lifted in the case of such a lesion is much larger and may be as large as 15 cm. Commonly no copious gumming or other secretion accompanies these lesions. The tissues of the eruptions eventually die, insects and secondary fungi obtain an entrance under the lifted bark and the ultimate effect of the disease is to kill the affected limb or whole tree. Such a tree is shown in plate 8.

These lesions agree in detail with the description of California scaly bark or psorosis as described by Swingle and Weber [3] from Florida and Fawcett [4] in California. There are two slight differences which, however, may be easily explained by greater severity of the disease under tropical climatic conditions and

[3] SWINGLE, W. T. and WEBER, H. J. The principal diseases of citrus fruits in Florida. U. S. Dept. Agr., Div. Veg. Phys. & Path. Bull. 8 (1896).

[4] FAWCETT, H. S. Citrus diseases of Florida and Cuba compared with those of California. California Agricultural Experiment Station, Bull. 262 (1915).

The lesions of California scaly bark on sweet orange, *Citrus sinensis*, about natural size

A view of the lesions of scaly bark on sweet orange, *C. sinensis*, after the overhanging bark has been removed, showirg the whorls of erupting tissue, about natural size

(*a*) Cut through an area of affected tissue, showing young active tissues pushing through the outer bark, about natural size

(*b*) The erupting tissues shown in the preceding figure are shown here after being dissected out: their origin and type of out-growth is shown here, about natural size

possibly by the different characters of the hosts under observation. The differences are: first, larger eruptions in the Philippines than in California; second, a more pronounced girdling in the case of the disease in California, whereas in the Philippines the disease not only extends laterally around a limb but also rapidly extends longitudinally over a limb.

It therefore seems reasonable to consider the Philippine disease of sweet orange trees as identical with California scaly bark or psorosis.. To one familiar with psorosis as it exists in California, in the case shown in the photograph plate 6, figure 1 is sufficient to establish the identity of the Philippine disease. The disease is also found on the pummelo and grapefruit trees but somewhat less severely. It attacks only trees well along towards maturity, that is, at least four or five years old, and has never been observed by the writer in nursery trees. No varietal resistance of sweet orange hosts has been observed as yet.

Altho the disease has been suspected of being infectious, it is to the present time still unproven and the causal organism is not known.

Psorosis in China and Japan and other Pacific Islands.—This disease occurs throughout South China and there as in the Philippines it is the limiting factor in the successful production of sweet oranges. The orchards of sweet orange trees there have never been observed to survive; an age of fifteen years and an age of ten or twelve years is probably above the average. The average length of bearing for orchards in South China is limited by this disease to ten years at the most.

In Japan the disease is not so common since sweet orange varieties are not as commonly grown. It has been observed there upon trees of the *Daidai,* a Japanese variety of *Citrus aurantium,* and there is entirely no difference between the lesions as found in Japan and those found in California. California scaly bark has also been observed by the writer on trees of sweet orange varieties in Guam and the Hawaiian Islands. To the writer's knowledge this disease has not been previously reported from these islands or from the Philippines, China, or Japan. Psorosis was not observed by the writer in Java altho many orange groves were visited.

The origin of California scaly bark.—*Citrus sinensis* as the specific name would imply is usually considered as having originated from South China; in any case it is certain that the sweet orange has been long cultivated in China. It is becoming a

commonly accepted theorem of research men in plant pathology that in countries where a host plant has been long existant, or is indigenous, there will be found the greatest number of diseases of that crop plant. One would expect from this viewpoint that probably psorosis originated in South China and was disseminated to other countries with citrus plant introductions. Certainly there have been few citrus plant introductions into China until recent years while there have been repeated introductions from China for centuries past. The viewpoint of the whole, extensive distribution of psorosis in citrus-growing countries impresses one with the necessity for the restriction of the distribution of other citrus diseases which exist in the countries of the Far East.

BARK ROT UPON MANDARIN ORANGE TREES

Description.—Altho mandarin orange trees are killed in much the same way as are the sweet orange trees, the individual lesions are considerably different. The most obvious symptom is a white foam or froth exuding from longitudinal cracks in the bark as shown in plate 4. This white exudate is not as one might hastily conclude, a bacterial ooze, but is found to be a mass of yeast cells and mycelium of a fungus which might roughly be referred to the genus *Hormiactis*. These organisms apparently causing this white ooze are believed to be secondary agents.

Closer examination shows that the disease is primarily a solution of the soft, actively functioning cells of the bark. The bark cracks as a result of this process and insects apparently attracted by the products of the solution obtain entrance thru the cracks in the bark. Thew hite exudate is apparently the result of the activity of these secondary insects. Following the initial cracking of the bark, the tissues are killed both longitudinally and laterally resulting in a final killing of the affected limb.

Direct injury results from the gradual increase of these lesions and subsequent dying of the tissues, finally resulting in a complete girlding of the limb or trunk. Usually, however, long before complete girlding has taken place, the lesions have afforded means of entrance for insect borers and similar destructive agents and deaths is apparently hastened. The disease progresses slowly in comparison with other citrus diseases, but the results are none the less serious. Killing caused by bark rot is shown in plate 7.

The type of lesions caused by bark rot is shown in plate 5 and in plate 6, fig. 2. The lesions of bark rot extend well up

White ooze, the most obvious symptom of bark rot

into the tree and have been observed upon limbs as small as 1½ cm. in diameter, the disease differing in this respect from foot rot and the types of gummosis as known in California. Bark rot in the Philippines as compared with these diseases also differs in the non-production of gum.

This disease of mandarin orange trees was given the name of bark rot by Wester [1] altho as used by him it also included the disease of sweet oranges shown in the present paper to be identical with California scaly bark or psorosis. Bark rot is most serious on the mandarin orange varieties, *Citrus nobilis* var. *deliciosa*, altho it has also been observed on Unshiu (*Satsuma*) varieties, *Citrus nobilis* var. *unshiu*, cabuyao trees, *Citrus hystrix*, and calamondin trees, *Citrus mitis*. Questionable lesions have also been observed on the lemon, *Citrus limonia*.

Comparison of California scaly bark with bark rot.—The two diseases, California scaly bark and bark rot, are identical in their final effects, that is, in the ultimate killing of affected trees thru the girlding of the limbs or the trunk; also in their simultaneous occurrence in Batangas Province, and their identical distribution in China, Japan and the Philippines. The lesions of bark rot differ from those of California scaly bark in that the former apparently are the results of solution of the tissues; in the case of the latter they are the results of stimulation of the cells causing eruption of the tissues. Bark rot lesions are accompanied by the white ooze shown in plate 4; this white ooze has never been observed by the writer accompanying psorosis on sweet orange trees. The diseases differ also in the hosts attacked; California scaly bark or psorosis attacks sweet orange trees, cabuyao trees, and pummelo and grapefruit trees. Bark rot attacks mandarin orange trees, unshiu orange trees, and calamondins.

Losses caused by bark rot.—This disease has since 1911 gradually killed off a large part of the orchard and door-yard trees of Batangas Province. Altho newly planted orchards bear for a few years, with increasing age they become affected and ultimately become thinned out and then eliminated.

The writer observed bark rot to be universally distributed throughout South China; in the Canton delta, in the Swatow delta, at Amoy, and as far north as Foochow. Foochow has a latitude of about 26° North and is well towards the northernmost limits of the citrus industry in China. The disease was also observed in Japan, in Nagasaki, and Wakayama Prefec-

---

[1] WESTER, P. J. The situation in the citrus district of Batangas. Phil. Agr. Review, Vol. VI, No. 3 (1913), p. 125.

tures. It is believed that the temperature of neither Florida nor California would prove a limiting factor to the development of the disease.

Bark rot is believed to be indigeneous to South China. An aspect of its seriousness in that region may be gained by the statement that not a single mandarin orange tree was observed in the Canton delta over fifteen years old. For the most part most of the orchards were reduced to a few isolated trees when they reached the age of ten or twelve years. In orchards at Ku Chan near Siulam and at Sii Ui, two of the large mandarin orange-growing districts in the Canton delta, not an orchard over six years old was seen which did not have fifty per cent or more of the trees affected.

In Japan, bark rot is apparently not as devastating altho it is an extremely destructive disease nevertheless. It limits the length of life of mandarin orange trees in very much the same way as scaly bark does for sweet orange trees. In Japan, bark rot next to foot rot and scab is probably the worst disease of mandarin and unshiu orange trees.

Autho seedling mandarin oranges are grown extensively in Java, and many groves were visited, the writer did not see a single case of bark rot in that country. The production of mandarin oranges is an important industry in Java, and the prevention of the introduction of the disease into that country would seem very important. The climate in Java is almost identical to that of the Philippines so that serious results would be expected should the disease be introduced. Bark rot was not observed by the writer in the Hawaiian Islands or Guam and to the writer's knowledge has not been observed or reported in California or Florida.

The possibility has been considered of this type of disease being identical with the *Diplodia* gumming of South Africa and Florida; neither Pole Evan [5] in South Africa nor Fawcett and Burger [6] in Florida make any mention of a white ooze in connection with the *Diplodia* disease in those countries while frequent mention is made in the literature of the gumming resulting from *Diplodia* infection on citrus hosts. A letter from Miss Doige, Chief of the Division of Botany, Union of South

---

[5] POLE EVANS, I. B. On the structure and life history of *Diplodia natalensis* n. sp. Union of South Africa Department of Agricultural Science Bull. 1 (1911).

[6] FAWCETT, H. S. and BURGER, O. F. A gum-inducing Diplodia of peach and orange. Mycologia Vol. III, No. 3 (1911), p. 151.

Old lesions of bark rot on tree of mandarin orange

(*a*) A trunk of a sweet orange tree affected with California scaly bark

(*b*) A trunk of a mandarin orange tree affected with bark rot

Africa, states that *Diplodia natalensis* commonly attacks sweet orange trees, *C. sinensis,* but has never been observed on mandarin orange trees, *C. nobilis;* the statement is made, moreover, that *Diplodia* infections usually occur near the ground level and that not white ooze has ever been observed. From these publications and correspondence there are apparently considerable differences between the oriental disease of mandarin orange trees which is being called bark rot and the *Diplodia* gumming disease of Florida and South Africa which attacks sweet orange trees.

THE PREVENTION OF SCALY BARK AND BARK ROT

Altho no carefully controlled experiments have been carried on in the Philippines primarily against these diseases, some data is available indirectly as a result of spraying experiments. In 1917 and 1918 spraying experiments were carried on against citrus canker at the Lamao (P. I.) Horticultural Station. At the time very little bark rot or scaly bark was apparent. Early in 1920, a survey of the experimental orchard showed no cases of either bark rot or scaly bark on the trees in the plats which had been sprayed. On the trees in the unsprayed plats one sweet orange tree had already died from scaly mark and three other sweet orange trees showed well advanced lesions. Of the mandarin orange trees four showed bark rot. This data of course can not be taken for more than an indication that bark rot and scaly bark can be prevented by applications of fungicides. At the Tanawan Commercial Citrus Station where painting the mature limb of mandarin orange trees with Bordeaux mixture has been practiced, no bark rot has developed as yet altho orchards of private owners nearby which have been untreated have shown a great deal of the disease. The indications are therefore that fungicides will prevent these diseases altho careful, controlled experiments are wanting to show this point conclusively.

Psorosis apparently does not yet exist in Java and probably it will be found to be still absent from many other citrus-growing countries. Bark rot apparently does not yet exist in California, Florida, Java, or the Union of South Africa. It would seem to be extremely important to prevent the introduction of these two disease into citrus countries where they do not yet exist and the most rigid quarantine and plant inspection measures should be instigated by such countries. It is very obvious that the cheapest control of such diseases is entire exclusion.

A limb of a mandarin orange tree, entirely girdled and killed by bark rot

A sweet orange tree killed by psorosis or California scaly bark in the Philippines

The Philippine Agricultural Review

VOL. XVI FOURTH QUARTER, 1923 No. 4

A QUARTERLY PUBLICATION

ISSUED IN ENGLISH BY THE
BUREAU OF AGRICULTURE

The Government of the Philippine Islands
Department of Agriculture and Natural Resources

Subscription rates: ₱2 (Philippine currency) or $1 (U. S. currency) per annum in the Philippine Islands and the United States and territories.
$2 (U. S. currency) per annum in foreign countries

MANILA
BUREAU OF PRINTING
1923

(Entered at the Post Office at Manila as second-class matter)

THE PHILIPPINE

Agricultural Review

VOL. XVI FOURTH QUARTER, 1923 No. 4

TABLE OF CONTENTS

	Page
1. A study of Macrosporium Disease of Onions *(Allium cepa L.)*, by Nicanor G. Teodoro y Gregorio	233
2. Soap as an Effective Contact Insecticide for the Philippine Migratory Locust, by Faustino Q. Otanes	281
3. Character and Usefulness of Fibers from Petioles of Buri Palm with Measurements of the Tensile Strength of Fibers, by R. B. Espino and G. C. Zabella	287
4. General Characters of some Philippine Weed Seeds, by Eduardo Quisumbing	298
5. The Polo Copra Drier, by H. J. Detrick	352
6. Book Review	365

ILLUSTRATIONS

Facing page—

PLATE I. Two rows of "Egyptian onion" *(Allium cepa*, var. *bulbellifera)*, planted from bulbils in the spring of 1920. Allowed to remain in the ground over winter. These plants furnished materials for inoculations in the following spring. Photographed April 29, 1922. Stalks bearing the clusters of bulbils are not yet formed ... 274

II. Stalks of "Egyptian onion" *(Allium cepa*, var. *bulbellifera)*, affected with leaf mold disease, showing the stage of the development of the disease. Note the incipient lesions, white and sunken (*a*), which gradually enlarged (*b*), became brown or black due to the formation of conidia of the causative fungus, *Macrosporium parasiticum* (*c*), and grew into linear depression—browning and killing the tissue (*d*) and (*e*) ... 274

III. Seed stalks of common onion (*Allium cepa* L.) attached with *Macrosporium parasiticum*. Note the black velvety coating which involves the entire stalk and the production of perithecial bodies. The last three flower-stalk were cut off by the invasion of the disease ... 274

IV. Photograph of a portion of the stem of overwinter seed stalk of "Egyptian onion" collected in the spring, showing matured perithecia ... 274

V. Inoculated leaves of white variety of *Allium cepa* grown in the greenhouse: (*a*) and (*b*) inoculated with spore suspeision from 12-day-old potato dextrose agar culture of conidia strain, and (*c*) similarly inoculated with ascospore strain. Photographed six days after inoculation ... 274

VI. Two stalks of *Allium cepa*, var. *bulbellifera* grown in the phatological garden, inoculated with spore suspension from 12-day-old culture of conidia strain. Photographed two weeks after inoculation ... 274

VII. *Allium cepa*, var. bulbellifera growing in the pathological garden, inoculated with bits of mycelium from 5-day-old culture. Note the girdled condition of the inoculated part (x). Photographed 10 days after inoculation ... 274

VIII. All drawings made under Zeiss 6 mm. apochromatic objective with No. 4 compensating ocular, and with the aid of Abeb-camera lucida ... 276

Fig. 1. Matured conidia from 12-day-old potato dextrose agar culture ... 276

2. Conidia germinating in onion scale decoction after 12 hours ... 276

3. Conidia germinating in distilled water ... 276

4. Mycelium growing in onion leaf decoction in Van Tieghem cell ... 276

5. (*a*) and (*b*) young fertile hyphæ before abstriction; (*c*) a very young spore formed at the tip of conidiophore; (*d*) an old fertile hypha, showing the growth of new hypha, which arises not from the swollen cell but from the cell below, and grows through the middle of the older piercing the wall at its tip; (*e*) a common form of hypha seen in potato dextrose agar culture; (*f*) and old hypha which has shed its spore, its upper wall has collapsed and assumes a characteristic cup-shaped form; (*g*) a mode of formation observed in early culture; (*h*)- (*k*) common forms seen to pure cultures, (*h*) and (*g*) younger stages; (*l*) and (*m*) observed in distilled water ... 276

IX. Fig. 1. Photomicrograph from microtome sections of sterile perithecia which developed in pure culture on potato dextrose agar plate. Fixed, infiltrated with paraffin, and stained with Fleming's triple stain ... 278

2. Photomicrograph from a section through an overwintered tissue of onion stem, showing the vertical section of a perithecium. Fixed in Gilson's fluid, infiltrated with paraffin, and stained with Fleming's triple ... 278

3. Drawn with the aid of camera lucida. (*a*) a young ascus; (*b*) an ascus with a slender paraphysis; (*c*) matured ascospores; and (*d*) and (*e*) two matured asci each containing eight ascospores ... 278

Facing page—

X. Petri dish and test tube cultures, grown from bits of mycelium. All 14 days old 280
Fig. 1. Potato dextrose agar........ 280
2. Potato dextrose agar with increased amount of sugar........ 280
3. Peptone agar with little sugar........ 280
4. String bean agar........ 280
5. Potato dextrose agar........ 280
XI. All the plates were inoculated with bits of mycelium of nearly uniform size, and incubated for 10 days at temperatures ranging form 4° to 35° C........ 280
XII. Atansoff's tube used to determine the moisture relation of the fungus........ 280
XIII. A series of petri dishes containing equal amounts of potato dextrose agar previously adjusted to different hydrogen-ion concentrations, ranging from pH 2.4 to pH 7.2. Inoculated with bits of mycelium of approximately the same size as could be estimated. Kept at room temperature under a bell jar. Photographed after 10 days from the time of inoculation........ 280
XIV. Photomicrograph from the wall of the petri dish culture. Note the growth of the fungus from the cut edge of the agar........ 280
XV. Photomicrograph from a certain field of the preceding plate, highly magnified.. 280
XVI. Figure 1. Photomicrograph from the wall of the petri dish culture, showing the formation of perithecia. Note the growth from the cut edge of the agar........ 280
2. Photomicrograph from a petri dish agar culture, showing perithecial bodies, later stage of the above........ 280
XVII. Photomicrograph from a certain field of Fig. 1, Plate XVI, highly magnified. (Small spores are concidia of another fungus)........ 280
XVIII. Stomatal penetration of *M. parasticum*. A thin portion of the epidermis removed from the surface of a white onion leaf directly beneath the infection drop. Fixed and stained Pianese stain two days after inoculation. Drawn with the aid of camera lucida........ 280
XIX. Figure 1. Cross-section of a leaf of white onion inoculated with spore suspension. Note the germ tubes passing through the stomata, also the portions of mycelium between and within the cells. Preparation made 5 days after inoculation. Fixed Gibson's fluid, infiltrated with paraffin, and stained with Fleming's stain. Drawn with the aid of camera lucida........ 280
2. Cross-section through an advance lesion of naturally infected stem of "Egyptian onion." Note the mycelium beneath the cuticle and sending hyphal branches through the ruptured cuticle, and note also the penetration to the deepest layers of cells. Fixed, stained, and drawn as above........ 280
XX. Photomicrograph from a cross-section of a dry stem of "Egyptian onion" naturally infected with *M. parsiticum*. Note the advanced decomposition of the tissue of the host. Note the hyphæ making their way to the surface, either through the stomata at (X) or directly through the cuticle at (Y). Fixed and stained as in the preceding preparations........ 280
XXI. Figure 1. Transversal section of a petiole 2½ meters from the base of the leaf showing the distribution of fibers and showing portions A, B, C, and D........ 288
2–5, inclusive. Fiber cells (lengthwise) from A, B, C, and D, respectively 288
XXII. Figures 2–4, inclusive. Cross-section of vascular bundles from A........ 288
5. Cross-section of a scelerenchyma strand from portion A........ 288
XXIII. Figures 1–3, inclusive. Cross-sections of vascular bundles from portion B.... 288
4. Cross-section of scalerenchyma strands from portion B........ 288
XXIV. Figures 1–4, inclusive. Cross-sections of vascular bundles from portion C.... 288
5. Cross-section of sclerenchyma strand from portion C........ 288
XXV. Figures 1–4, inclusive. Cross-sections of vascular........ 288
XXVI. Figures 1–3, inclusive. Cross-sections of fibers from the market........ 288

			Facing page—
XXVII.	Figure	1. Seeds of *Coix lachryma-jobi* L. Natural size	310
		2. Seeds of *Imperata cylindrica* (Linn.) Beauv. x 10	310
		3. Seeds of *Saccharum spontaneum* L. subsp. indicum Hack. x 10	310
		4. Spikelets and seeds of *Andropogon halepensis* (Linn.) Brot. var. *propinquus* (Kunth). x 5	310
		5. Florets and seeds of *Paspalum longifolium* Roxb. x 5	310
		6. Florets and seeds of *Paspalum scrobiculatum* Linn. x 5	310
		7. Seeds of *Panicum colonum* Linn. x 5	310
		8. Spikelets, florets and seeds of *Panicum crus-galli* Linn. x 5	310
		9. Florets and seeds of *Panicum repens* Linn. x 5	310
		10. Florets and seeds of *Panicum flavidum* Retz. x 5	310
		11. Florets of *Setaria* geniculata (Lam.) Beauv. x 5	310
		12. Florets and seeds of *Cynodon dactylon* (Linn.) Pers. x 5	310
		13. Spikelets and seeds of *Eleusine indica* (Linn.) Gaertn. x 5	310
		14. Nutlets of *Cyperus difformis* Linn. x 10	310
XXVIII.	Figure	15. Nutlets of *Cyperus iria* Linn. x 5	320
		16. Spikelet and nutlets of *Cyperus compressus* Linn	320
		17. Nutlets of *Fimbristylis annua* (All.) R. & S. x 10	320
		18. Nutlets of *Fimbristylis miliacea* (Linn.) Vahl. x 10	320
		19. Nutlets of *Scirpus grossus* Linn. x 5	320
		20. Nutlets of *Scleria scrobiculata* Nees. x 5	320
		21. Seeds of *Commelina benghalensis* Linn. x 10	320
		22. Seeds of *Celosia argentea* Linn. x 10	320
		23. Seeds of *Amarnathus spinosus* Linn. x 5	320
		24. Seeds of *Amaranthus viridis* Linn. x 5	320
		25. Seeds of *Achyranthes aspera* Linn. x 5	320
		26. Seeds of *Portulaca oleracea* Linn. x 10	320
		27. Capsule C(x $\frac{2}{3}$) and seeds, S(x 10) of *Gynandropsis gynandra*	320
		28. Seeds of *Jussiaea linifolia* Linn. x 10	320
		29. Seeds of *Argemone mexicana* Linn. x 10	320
		30. Seeds and portion of pod of *Mimosa* pudica Linn. x 2.5	320
XXIX.	Figure	31. Seeds of *Cassia occidentalis* Linn. x 2.5	320
		32. Seeds of *Cassia tora* Linn. x 2.5	332
		33. Seeds of *Desmodium triflorum* (Linn.) DC x 5	332
		34. Seeds of *Alysicarpus nummularifolius* (Linn.) DC. x 4	332
		35. Seeds of *Indigofera hirsuta* Linn. x 5	332
		36. Seeds of *Indigofera suffruticosa* Mill. x 5	332
		37. Seeds of *Sesbania cannabina* (Retz.) Pers. x 4	332
		38. Seeds of *Biophytum sensitivum* (Linn.) DC. x 10	332
		39. Fruit (x 2) and seeds (x 5) of *Triumfetta semitriloba* Jacq	332
		40. Seeds of *Corchorus capsularis* Linn. x 5	332
		41. Seeds of *Corchorus olitorius* Linn. x 5	332
		42. Seeds of *Chorchorus acutangulus* Lam. x 5	332
		43. Seeds of *Malachra capitata* Linn. x 5	332
		44. Seeds of *Abutilon indicum* (Linn.) Sweet. x 5	332
		45. Seeds of *Melochia concatenata* Linn. x 5	332
XXX.	Figure	46. Seeds of *Hyptis suaveolens* (L.) Poir. x 5	340
		47. Seeds of *Leucas aspera* (Willd.) Spreng. x 7	340
		48. Seeds and *Leucas lavandulifolia* sm. x 5	340
		49. Seeds of *Leucas javanica* Benth. x 10	340
		50. Seeds of *Borreria hispida* (Linn.) K. Schum. x 5	340
		51. Achenes of *Ageratum conyzodes* Linn. x 5	340
		52. Achenes of *Elephantopus mollis* HBK x 5	340
		53. Achenes of *Elephantopus scaber* Linn. x 5	340
		54. Achenes of *Elephantopus spicatus* AuBL. x 5	340
		55. Achenes of *Synedrella nodiflora* (Linn.) Gaertn. x 5	340
		56. Achenes of *Eclipta alba* Linn. Hassk. x 5	340
		57. Achenes of *Cosmos caudatus* HBK. x 1.33	340
		58. Achenes of *Bidens leucorrhiza* (Lour.) DC. x 1.33	340
		59. Achenes of *Blumea balsamifera* (Linn.) DC. x 5	340

Facing page—

XXXI. (a) Front view of the Polo Drier in operation at the Polo Coconut Plantation, Tanjay, Oriental Negros 352
(b) The Polo Copra Drier: showing the trays in position in one section 352
XXXII. (a) Polo Copra drier, showing the open door above the furnace, and a perforated corrugated sheet iron placed above the boiler below the drying chamber serving as baffleplate 354
(b) Model of one section of the Polo Copra Drier, showing details 354
XXXIII. (a) Model of section of the Polo Copra Drier, showing details 356
(b) Model of section of the Polo Copra Drier, showing details 356
XXXIV. (a) Model of a section of the Polo Copra Drier, illustrating insertion of a tray filled with coconut meat 360
(b) Model of a section of the Polo Copra Drier, illustrating removal of a tray of dried copra 360

TEXT FIGURE

Figure 1. Tensile strength of fibers from different petioles 290

A STUDY OF A MACROSPORIUM DISEASE OF ONIONS [1]

By Nicanor G. Teodoro

INTRODUCTION

The investigation detailed herein deals with a Macrosporium disease of onion commonly known as black stalk rot, black mold or leaf mold. The latter name is preferred and herein adopted by the author because it seems the more descriptive of this disease which affects the aërial parts of the onion plant.

The disease has long been recognized as a disease which affects the stems and leaves of "Egyptian" onion (*Allium cepa*, var. *bulbellifera*) and "Common" onion (*Allium cepa* Linn.). *Macrosporium parasiticum*, a fungus which causes this disease, has generally been considered a secondary parasite to onion mildew and incapable of independently infecting the onion. It has, therefore, become the purpose of this investigation to determine whether this organism is capable of acting as an independent parasite and of causing the leaf mold disease of onions.

THE DISEASE

HISTORY AND GEOGRAPHICAL DISTRIBUTION

Von Thümen(12), who first called attention to the occurrence of *Macrosporium parasiticum* on onions collected in Bavaria, stated that the fungus was parasitic, for the most part, upon onions already infected by *Peronospora schleidenia*. Shiply(10) reported this fungus as prevalent in Bermuda and stated also that it is only found upon the onion after it has been attached by the Peronospora. It is, therefore, considered in this case as a sequel to the Peronospora rather than a specific disease in itself. Farlow in an appendix to the paper of Miyabe(6)

---

[1] A thesis presented to the faculty of the Graduate School of the University of Wisconsin in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

It is with great pleasure that the writer expresses his grateful acknowledgements and thanks to Professor L. R. Jones, under whom the work was undertaken, to Dr. J. C. Walker for suggesting the problem and for constant direction and advice during the progress of the investigation and to Professor E. M. Gilbert for valuable suggestions and kindly criticisms in the final preparation of the manuscript.

stated that he noticed an abundance of *Macrosporium parasiticum* in the numerous specimens of diseased onions sent him by Tucker of Bermuda for Miyabe's study at that time, and to his surprise no trace of either *Peronospora schleidenia* or *Urocystis cepulac* was seen. Thus some botanists have found that the fungus attacks onion plants following Peronospora, while others report that it occurs independently causing a specific disease of onions. In Wisconsin, where mildew seldom occurs, *M. parasiticum* is found repeatedly, apparently causing distinct lesions on leaves and seed stems of onion, and often girdling the latter.

Thaxter(11) sum up the conclusions he reached from investigations in Connecticut as follows:

"That it is entirely independent of Peronospora was easily shown from the fact that, although the latter fungus was observed only in the region about Wethersfield, the *Macrosporium* was found wherever the onion was cultivated. At Green's Farm and at Southport, for example, a careful examination of numerous fields, both of seed and market onions, did not disclose a single instance of injury from the mildew, while the *Macrosporium* was everywhere abundant. That the two diseases are not necessarily associated can therefore be definitely stated; but whether the *Macrosporium* is in itself a primary cause of disease in onions, is another matter not so easily determined. That it usually follows an injury of some sort may be inferred from its almost invariable association with the *Peronospora,* as well as with the injury produced by the onion Thrips, yet in several cases during the past season it was observed where no such previous injury was apparent.

It may be mentioned in passing that Thaxter attempts to produce the disease by sowing the spores upon healthy onion leaves were not successfully. However, he expressed the opinion, as a result of his observations, that the fungus is seriously injurious whether it be primary or secondary in nature.

In a recent publication based on studies in Louisiana, Edgerton(2d) says:

"The mildew is very common and frequently injures the plants very badly. Plants injured by the mildew are always overrun by the Macrosporium. In the literature on onion diseases it is generally assumed that the Macrosporium outbreaks follow attacks of the mildew. Yet under Louisiana conditions this is not always the case, as the black stalk rot is often common in fields in which no mildew can be found."

In his attempt to produce the disease in living plants, Miyabe, in the paper already referred to, may be quoted in part as follows:

"A large number of young onion plants were started both from seeds and bulbs. The spores were sown on different parts of the leaves, and the pots were kept moist under bell jars, with the exception of a few which were left uncovered. The greater part of the young seedlings were badly injured by nematoid worms; but those which survived did not show any sign of the attack. Out of the twelve bulbs, the culture on only two was successful. The spores, however, grew in both cases only on the sheath of the leaves, and not on the active green portions. One of them produced the Macrosporium-spores in small quantity, while the other formed in addition a large number of perithecia . . ."

Very little is known of the distribution of this disease in the past. However, according to the report given in the Plant Disease Bulletin(3) the disease occurred in the United States in the following states: Massachusetts, Louisiana, Ohio, and Washington; and prior to 1918 it has been reported, in addition to the above-named states, from Rhode Islands, Connecticut, New York, Ohio, Indiana, Michigan, and Utah.

Edgerton(2a, 2b) reported that the disease caused considerable damage in seed onion crop as well as in field onion. According to him the disease attacks the stems covering them with a black mold and causing them to rot and fall over. His recent report(2c) states that the black mold disease together with the downy mildew have decreased the seed crop to a great extent.

In the summer of 1920 the writer observed *Macrosporium parasiticum* causing considerable damage in common onion at Racine, Wisconsin, and the same fungus was found attacking "Egyptian" onion at Madison, Wisconsin.

SYMPTOMS

The disease is most conspicuous on leaves and seed stalks of common (Plate III) and "Egyptian" onions (Plate II), occurring very rarely on bulbs. It apears first as small white sunken spots which gradually enlarge into depressed linear lesions. These gradually become brown or black in color due to the formation of conidia, which in moist weather become so abundant as to cause a deep black, velvety appearance. The disease often follows tipburn. Stems and leaves attacked by the fungus are commonly girdled they break and drop down.

ECONOMIC IMPORTANCE

This disease has been considered of minor importance but has become destructive in recent years. Edgerton (2a) reported the disease as general in Louisiana for nine years, causing considerable damage since 1918. The estimated loss to the seed onion crop is 25 per cent. In 1920 the same author (2b) reported the disease to be severe in seed onions in the Bayou La Fourche district of Louisiana. Last year, 1921, (2c) he reported thus: "Very common as usual on the seed onions. This disease together with the downy mildew has decreased the seed crop about 50 per cent."

THE CAUSAL ORGANISM

TAXONOMY

This fungus, *Macrosporium parasiticum,* was first named and described by Von Thümen (12) in 1887. Miyabe (6), in his thorough mycological study of the life history of this fungus, has definitely and conclusively shown that *M. parasiticum* Thum. is an imperfect stage of *Pleospora herbarum* (Pers.) Rabh.; the latter was first named by Persoon (7) as *Sphaeria herbarum* and later changed by Rabenhorst to *Pleospora herbarum.* Miyabe has further established the fact that *Macrosporium parasiticum* is identical with *M. sarcinula* of Berkeley which the latter author named and described in 1837.

The descriptions given by Von Thümen regarding the conidial stage, and by Rabenhorst concerning the ascigerous stage, and latter amended by the elaborate, detailed descriptions by Miyabe are in complete accord with the results of the writer's observations. Inoculation experiments and cultural studies leave no doubt as to the genetic relationship of *Macrosporium parasiticum* and *Pleospora herbarum.*

MORPHOLOGY

The results of the present studies of the morphology of the fungus are entirely in harmony with the descriptions given by the above-mentioned investigators, except that the writer's measurements of the spores are a little less than those given by Miyabe and Von Thümen.

As has been stated, the fungus *Macrosporium parasiticum* Thüm. has two stages in its life history, namely: (1) the conidial stage parasitic on the leaves and seed stalks of onions, and (2) an ascigerous stage which sometimes develops in living plants but usually occurs the following spring on the dead leaves and seed stems infected during the previous season.

Conidia (*Macrosporium parasiticum*) or imperfect stage. Examination of the diseased spots reveals the presence of the mycelium penetrating the deepest layers of cells. This mycelium produces a tuft of smoky white hyphæ which emerge through the stomata and sometimes directly through the ruptured epidermis. They bear dark brown conidia. In pure culture of the organism, the mycelium measures from 2.5 to 6.8 microns in diameter. It is smooth, septate, and branching. The branches which arise laterally anastomose with one another and the cells are filled with oil droplets. The color of the mycelium varies with age. At first it appears hyaline, then the walls thicken assuming a smoky white to light, yellowish brown color, with frequent septation, and later it becomes deep brown and greenish. The fertile hyphæ or conidiophores arising directly from the mycelium, when mature, are smoky white to deep brown in color except near the base where they are hyaline. These hyphæ are simple, septate, smooth, and sometimes branched. They are occasionally swollen at their bases, and more constantly so at their free ends, where the conidia are borne. These spore-bearing cells are always deeper brown in color than the rest of the hyphae. Their walls are greatly thickened around their lateral sides in the form of a band, but are thinner in texture and lighter in color at their terminal portions. In some of the older hyphæ which have shed their spores and ceased to grow these terminal portions collapse and assume a characteristic cupshaped form.

As described and figured by Miyabe new growth of hypha occurs at the free end of the original hypha where the spore has once been borne. While in a Bermuda specimen which he had also studied, he found a far more common form where new growth takes its origin from the cell next to the swollen cell at the end of the same hypha. This secondary hypha grows through the middle of the swollen cell, piercing it at its upper wall (Plate VIII, Fig. 4d). The same development of secondary hyphæ was also observed by the writer in his studies, using favorable nutrient substrata. There were observed, also hyphæ which arose from the spot where the spore had once been borne.

There were cases where a long extended hypha produced a spore on its tip. From this same hypha a short branch was given off laterally showing two or three swollen cells, each producing a spore (Plate VIII, Fig. 5m).

The young spores produced at the tip of the hyphæ are at first colorless, smooth, and ovate in form. As these conidia approach maturity they become somewhat oblong, dark brown,

and are divided by cross partitions into numerous cells, making a compound muriform spore. They are covered with numerous short projections. They vary in form and size. In form, Miyabe(6) describes them as ranging from oblong-obovate to depressed-rotundate, always rounded at both ends, and slightly constricted at the middle, usually at the principal transverse septa. Von Thümen's description of the mature conidia may very well be quoted in part as follows: "conidiis oblongo-ovides vel ovoideo-rotundatis vel clavatis, 6—10 septatis, utrinque obtusis."

They varied greatly in size both in nature and in pure cultures. For comparison, measurements of spores obtained from the lesions of the living plants and from sporulating cultures (17 days old) were made. One hundred spores were measured in each case. The results of these measurements were compared with those of Von Thümen and Miyabe.

TABLE 1.—*Measurements of Conidia of "M. parasiticum"*

Source	Number measured	Length in microns			Width in microns		
		Minimum	Maximum	Average	Minimum	Maximum	Average
Stem lesion of Egyptian onion	100	31.5	40.3	35.9	16.2	18.5	17.5
Potato dextrose agar	100	33	41.6	37.3	17.5	20.5	19
Von Thümen's measurements	......	42	48	.....	10	16	....
Miyabe's measurements	....	33	43	38	18	23	21

It will be seen from the above table that the average size of the spores is much less than that given by Von Thümen and Miyabe, however, it does not seem sufficient for specific separation.

Ascigerous (*Pleospora herbarum*) or perfect stage. This stage, which is found on dead leaves and stems as well as in living onion plants infected with *Macrosporium parasiticum,* and also produced in culture media, is characterized by the formation of spherical perithecia (Plate IV and Plate XVI). They are black in color, membranous and erumpent. Within these bodies are produced numerous asci (Plate IX, Figs. 2 and 3), each containing eight yellowish brown muriform ascospores (Plate IX, Fig. 3c). Among the asci are found slender paraphyses (Plate IX, Fig. 3b). The asci and paraphyses arise from the same basal cells. The paraphyses, which are much longer than the asci, are filiform, septate, and simple. The young asci are filled with granular colorless protoplasm. The matured asci are cylindrical-oblong in shape, tapering towards their basal ends, which are slightly dilated.

Rabenhorst's(9) description of this stage is as follows:

"Peritheciis subgregarious, epidermide prinitus tectis, dein ea perfossa nudatis, sphaeoroides-depressis, siccia collapsis vel varie impressis seu corrugatis, ostiolo papillato aut vertice obtuso umbonato osculo pertusis, glabris basi subinde fibrillosa, atris, 200–450 microns lat.; ascis clavatis, 110–160 $\times$ 20–30, octosporis; sporidiis distichis, ellipsoideis vel oblongatis, 7-septatis, murali-divisis, demum flavis vel fuscis, 30–40 X 16–18; paraphysibus filiformidubs, gracilescentibus."

PHYSIOLOGY

ORIGINAL ISOLATION

Source of pure culture.—The pure cultures of *Macrosporium parasiticum* used in these studies were obtained from freshly produced conidia from abundantly sporulating lesions of either the leaf or stem of naturally infected living onion plants. Single ascospore isolations of *Pleospora herbarum* were obtained from the onion stems which produced the perithecia in the spring.

Methods and technique of isolation.—In isolating the fungus, the three methods employed were as follows:

1. Conidia were picked off from abundantly sporulating lesions by touching the tuffs of conidiophores with a drop of sterile water on a platinum loop and then transferring to potato dextrose agar (a suitable medium for the fungus growth) slants or plates or, by the ordinary spore-dilution method, that is, the spores picked off as described above, placed in a drop of sterile water in a sterile petri dish and then cooled agar (45° C.) poured into the plate. In some instances the spores thus picked off were transferred to a tube of melted agar which had been cooled to a temperature of about 45° C. in a water bath. The spores were then thoroughly distributed throughout the melted agar by giving the tube a rotary motion without allowing the formation of air bubbles. The content of the tube was then poured into a sterile petri dish. When sufficient growth took place, transfers were made from the edge of selected colonies in the plate.

2. Isolations were also made from young lesions. The affected part of the host was thoroughly disinfected, either by wiping it with a piece of absorbent cotton moistened with mercuric chloride solution (1 to 1,000), and then the disinfectant removed by wiping with cotton moistened with sterile water; or simply reasonably small blocks of young lesions were cut,

plunged into 1 to 1,000 mercuric chloride solution in a tube for three to five minutes, and then washed in three changes of sterile water blanks in test tubes. The blocks thus treated were transferred to the surface of the hardened potato *dextrose* agar in petri dishes, their outer surface carrying infection against the agar.

3. Although pure cultures were obtained from poured plate dilutions of masses of spores (as in 1) and by transfers from original planting (as in 2), nevertheless, the method of obtaining pure cultures from single spores, as described by Dr. Keitt (5), is more exact in that it is free from admixture. Hence, this methods was used where it seemed necessary, especially where comparative study of a number of strains was made. The method was accomplished as follows: A spore suspension in sterile water in a test tube was prepared. From this suspension about one cubic centimeter was pipetted with a sterile pipette and placed in a sterile petri dish, then cooled water agar (45° C.) was poured into the dish. This had been previously prepared by dissolving 25 grams of agar in one liter of distilled water, steaming for two or three hours, and filtering through a cotton filter in an ordinary funnel and finally clarifying by running the filtrate through a Buchner funnel in which was placed a mat of macerated filter paper 3 to 5 mm. in thickness. Since germination of spores of Macrosporium is known to occur within about four hours at the most, the inverted plate was examined under the low power of the microscope, and a suitably located spores sending out germ tubes was marked by means of an ink dot on the petri dish. An incision was made about the spore by means of an instrument, a platinum needle the free end of which was flattened and coiled into a hollow cylinder of convenient size. It was inserted into the dish taking all the usual precautions to prevent contamination. After such incision was made and after ascertaining by means of low power of the microscope that the spore was uninjured, this cylinder of agar bearing the spore was removed, by means of another instrument made also of a platinum wire flattened at the free end, and deposited in a corresponding hole previously made in the agar in another dish.

In the case of ascospores, matured perithecia were placed in a drop of sterile water in the sterile petri dish, covered with a sterile cover glass, and then the latter was tapped to burst the perithecia. Examination under the microscope determined whether the ascospores were separated from the asci.

The cover glass was removed and then rinsed with a few drops of sterile water to wash the ascospores that might adhere to it into the dish. Melted agar was poured onto this preparation and single ascospores isolated in the manner described above.

For further studies or subsequent cultures, when the colony on the agar plate had reached the size of about 25 to 30 cm. in diameter, transfers were made by cutting small block from the edge of the colony and planting them in the center of the petri dishes or tubes, the side containing the mycelium being placed against the agar.

CULTURAL STUDIES

Relations of media.—A considerable number of different kinds of media, both natural and artificial, were used. The reasons for this were: (1) to gain a comprehensive knowledge of the extent of the variability in this fungus under changed or different conditions of nutrition found in various substrata; (2) to discover if possible, which media are adaptable in inducing the formation of spores and perthecia; and (3) to determine which media could thus be most profitably used in growing this organism under laboratory conditions.

The fungus was grown in at least ten cultures of each kind of the media used. A definite relation of the fungus to the particular medium used was based upon such studies.

Both macroscopic and microscopic examination of all the cultures grown in tubes, plates, and flasks were made from time to time. The results of such examinations showed that not one of the media used was successful in the production of spores when grown from either the mycelium, which developed from plated blocks of incipient lesions, or from the mycelium of many subsequent cultures originally obtained from single-spore cultures, unless the mycelium was injured. This is described later in the studies reported under "spore production."

The fungus grew readily upon a number of these different culture media. Following is a brief description of the characters of growth of the fungus on each particular medium used.

ARTIFICIAL MEDIA

SOLID

Unless otherwise stated, the media were sterilized in the autoclave at seven to fifteen pounds pressure, as the case might be, for three consecutive days.

Potato dextrose agar.—(Prepared by cooking 200 grams of peeled potato tubers in 1,000 cc. of distilled water. The liquid was decanted, restored to the same volume, and then 15 grams of agar and 20 grams of dextrose added, and cooked in the steamer for an hour.) This is the medium most commonly used in this work since it is the most adaptable for the growth of the fungus. On the plates, the colony became evident within about two days after the planting of a single conidium in the center of the petri dish. At first the mycelium was white, and then became smoky white to greenish brown with age. The colony of mycelium formed measured 41 mm. in diameter within one week. A little yellowish discoloration of the agar below the colony was visible, but such color did not diffuse throughout the medium. Conidia appeared from 5 to 6 days after the planting of a single conidium in the plate. When poured plates were made the colonies usually became macroscopic within two or three days. When fully developed they were regularly spherical in shape. In tubes (slants) the growth of the fungus was the same as that on the plates. The smoky white to greenish brown mycelium was flattened to the surface of the agar when conidia were produced. Where no conidia were produced the aërial mycelium grew abundantly. A yellowish color at the upper edge of the slant, which latter became reddish was sometimes formed. As the culture dried out the surface of the mycelial growth became first flat and smooth. By increasing the amount of sugar used in the above medium a far better growth of the fungus was observed (Plate X, Fig. 2).

Nutrient agar.—(The same as used for bacteriological work, 3 grams Liebig's beef extract, 15 grams of agar, and 10 grams of peptone in 1 liter of distilled water.) On this medium where no sugar was added the growth of the mycelium was sparse and flat, and dull brown in color. The fungus did not discolor the agar.

Onion-decoction agar.—(Prepared like potato dextrose agar, except that onion decoction, 100 grams of onion scale in 1 liter of water, was used instead of potato decoction.) Growth of fluffy mycelium was abundant as in potato dextrose agar.

Oat agar.—(Prepared by soaking 50 grams of Quaker oats in 500 cc. of distilled water held at 60° C. and stirred constantly. The liquid was strained through cheese cloth. Fifteen grams of shredded agar was dissolved in 500 cc. of distilled water and then added to the oats decoction; enough water was added to the mixture to make 1 liter of the medium. The whole

was then steamed for 30 minutes for three successive days.) The fungus grew well on this medium. It produced white mycelium and discolored the medium yellow ochre (Ridgway).

String-bean-decoction agar.—(The same as oat agar, except that 100 grams of ground string bean was used instead of Quaker oats.) The growth of this medium was rather poor as compared with the others. The color of the mycelium took the slight pink color of the medium (Plate X, Fig. 4).

Dextrose-peptone agar.—(Composition: peptone 10 grams, dextrose 10 grams, sodium chloride 5 grams, and agar 15 grams warmed and dissolved in 1,000 cc. of distilled water.) The fungus grew rapidly, showing a flat thallus with black circular area in the center (Plate X, Fig. 3).

Coon's synthetic agar.—(Coon's synthetic solution hardened with agar. The stock solutions of M/5 chemicals was prepared in four separate flasks as follows: magnesium sulphate + 7aq. 2.466 g. + 50 c. c. water; potassium acid phosphate 1.36 g. + 50 c. c. water; asparagin 1.33 g. + 50 c. c. water; maltose 3.60 g. + 50 c. c. water. For 100 c. c. synthetic solution 1 c. c. of M/5 magnesium sulphate and 5 c. c. of each of the other solutions were added to 84 c. c. of water together with 1.5 g. of agar sterilized on three successive days.) The mycelial growth of the fungus was flat and smoky white. No color was produced in this medium.

Small filter paper disks were also utilized to grow the fungus. Two or three layers of this were placed in each of the petri dishes used, moistened with distilled water, and autoclaved. This furnished a poor medium for the growth of this fungus. Practically little flat mycelial growth occurred within two weeks.

LIQUID

The different fluids used were: onion scale decoction, date decoction, potato decoction, and nutrient broth. The first two were prepared by cooking 50 grams each in 1 liter of distilled water; while the last two were prepared by the same method as is used in making hard media. The growth of the fungus was rather slow in any of these decoctions. Poor growth resulted in onion scale decoction. Fair growth of the fungus was shown in potato decoction and nutrient broth. The best result was obtained in the case of date decoction. After two weeks the entire surface of the nutrient solution was covered with deep brown mycelial growth forming a felt mass about 2 mm. in thickness.

NATURAL MEDIA

Potato plugs.—Large sound potato tubers were washed in running water, peeled, washed again in distilled water, and cut with a large cork borer into cylinders about two inches long. They were trimmed to a long slant at one end, and washed again in distilled water. Then they were placed in test tubes each tube being provided with a small wad of absorbent cotton at the bottom for a support. About 2 c. c. of distilled water was added to each tube which was then plugged and sterilized in the autoclave for three consecutive days at 7 pounds pressure for 20 minutes each day.

Growth of the fungus was moderately dense. The potato plugs were softened and a dark coloration resulted due to the black mat formed by the fungus around the surface.

Boiled string bean pods.—Fairly small pods were selected, washed in distilled water, and placed in test tubes, as in potato plugs, with a little distilled water and then autoclaved for 30 minutes at 15 pounds pressure. Growth was rather sparse. The color of the mycelium was smoky white to slightly pink.

Boiled rice.—(Prepared by putting 10 grams of rice and 50 c. c. of distilled water in a 200 c. c. Erlenmeyer flask, and autoclaving for 30 minutes at 15 pounds pressure.) The growth was very dense. At first the aërial mycelium was smoky white to dark brown, later became dark in the center of the growth the medium being yellow ochre color mixed with a slight pink.

Relations of temperature.—Believing that temperature might be an important factor in the development of the disease, effort was made to determine the relation of the growth of the causal fungus in cultures to different temperatures. This was accomplished as follows:

Poured plates of potato dextrose agar were made and when cool, bits of mycelium from the edge of a rapidly growing culture were planted in the center of each plate. The plates were grown in incubators at temperatures ranging from 4° to 35° C. or higher. The cultures were allowed to grow for 10 days, measurements (in millimeters) of the diameter of the colonies being taken daily. Triplicate plates were used for each temperature, the average for each series being taken as the average daily growth for each temperature. The total average diameter of the colonies at the end of ten days each temperature is given in the table below. A representative plate

from each temperature was selected and the whole series was arranged and photographed as shown in Plate XI.

TABLE 2.—*Showing the Growth of Mycelium of "Macrosporium" parasiticum at Various Temperatures*

Temperature Degrees centigrade	Average diameter of colonies in millimeter
3–4	9
5–6	11
7–8	14
9–10	20
11–12	35
15–16	44
19–20	54
22–23	64
27–28	55
29–31	45
32–33	25
34–35	8

It is obvious from the figures above that there was a slight growth at about 4° C. The development became accelerated at 7° to 8° C., and the rate of growth became more rapid from 11° to 23° C. From this point the growth gradually became slower until at 34° to 35° C. where practically little growth occurred. The plates which had been kept at the lower temperatures grew fast when they were removed to higher temperatures. The growth of the fungus at a constant temperature of 35° C. was retarded when not placed in a moist chamber.

From this behavior it is safe to conclude that the minimum temperature for growth of this fungus on the medium used is less than 4°C.; the optimum, about 20° to 23°C.; and the maximum, about 35°C.

Relations of moisture.—Culture media abundantly supplied with moisture showed vigorous growth of mycelium. This was shown by using Atanasoff's tube (Plate XII). The bulb which is attached near the lower end of the tube was filled with water and a piece of absorbent cotton placed on the bottom. A potato plug was then inserted just above the water level. The whole apparatus was sterilized in the autoclave, care being taken not to release the pressure suddenly since this would force the water out of the bulb into the tube. The water in the bulb supplied the tube with sufficient moisture by means of the cotton which served as a wick. Some of the water was used by the fungus and some evaporated. The moisture relation was further tested

by the following method. Twenty grams of corn meal was placed in each of four 200 c. c. Erlenmeyer flasks, and these were sterilized in the autoclave. Fifteen cubic centimeters of sterile distilled water was placed in one flasks, just enough to moisten the surface of the corn meal; 35 c. c. in the second, which completely moistened the entire content of the flasks; 40 c. c. in the third, making the corn meal entirely saturated; and the fourth was left dry, no water being added. Each flasks was inoculated with bits of mycelium bearing conidia. The experiment was continued for two weeks. The results were as follows:

TABLE 3.—*Relations of moisture*

Flask No.	Nature of growth
1	Poor.
2	Vigorous growth of aërial mycelium.
3	Vigorous growth of aërial mycelium.
4	None.

While sufficient moisture favors vigorous vegetative growth, the mycelium of the fungus could withstand long desiccation. This was tested by planting fragments of the mycelium on April 13, 1922, from a tube of potato-dextrose agar culture which was prepared on October 27, 1920, into two agar slants and two plates. Vigorous growth was obtained in each case.

This test indicates that the mycelium maintains life longer than the conidia. It is in this stage that the fungus can withstand unfavorable weather conditions in the tissue of dead leaves and stems of onions, and thus serve to perpetuate the fungus.

Relations of light.—In order to determine the effect of light upon this fungus, two sets of culture were prepared by placing bits of mycelium from the edge of a young culture in the center of the hardened potato-dextrose agar in petri dishes. One set was placed under the bell jar on the desk in the diffuse light of the laboratory. The other set was kept practically in the absence of light in Coon's (1) light-tight apparatus which was made as follows: From heavy Manila paper two open cylinders were made by gluing the opposite edges of sheets together. Both measured 12 inches long, one being 7 inches in diameter and the other 9 inches. The smaller was placed inside the larger. A cap was made which consisted of a disk of the same material 10 inches in diameter, with a short cylinder 8 inches

in diameter glued to the disk in such a way that it fitted between the two 12-inch cylinders. The upper rims of these two cylinders were toothed to insure circulation of air. These two cylinders after being properly fitted to each other were set in a shallow cardboard box. The entire apparatus was made light-tight by painting it with black paint. For a check, another set of cultures was placed in a similar case made of celluloid, but not painted with black and set aside as in the case of the bell jar above mentioned.

No marked difference was observed in the behavior of growth. The fungus exhibited normal growth of the mycelium in all cases.

Relations of oxygen supply.—The fungus is slightly sensitive to varying amounts of oxygen. This was demonstrated by the results obtained from growing the organism in different glass cylinders of uniform diameter and of various height, ranging from 50 c. c. to 500 c. c. capacity. These cylinders were filled to uniform depth with potato-dextrose agar, plugged with cotton and sterilized in the autoclave. Each cylinder was inoculated by placing in the center of the hardened agar bits of mycelium obtained from the edge of a young growing colony on a potato-dextrose agar plate. Immediately after inoculation all the cylinders were sealed with melted paraffin. A similar series was prepared, but not sealed with paraffin. The results obtained were as follows:

TABLE 4.—*Relations of oxygen supply*

Capacity of cylinder	Growth	
	Sealed	Not sealed
c. c.		
50	Slow, white, flat mycelium later degenerate.	Slow, but aërial.
100	do.	Medium, raised center.
150	Slow but somewhat raised center	Vigorous, raised center.
300	Medium, raised center	Do.
400	do	Vigorous, abundant, raised center
500	Vigorous, raised center	Do.

It will be seen from the above data that with a decreased amount of oxygen there resulted a comparative slow growth of the mycelium. Later this growth ceased and degeneration became evident during the progress of the experiment. Thus, the duration of the vitality of the culture is shortened by a limitted amount of oxygen supply. As the amount of oxygen was increased, in the case of sealed cylinders, the growth became

correspondingly vigorous. In the unsealed cylinders very slight difference was noticeable.

However, in the complete absence of oxygen the fungus did not grow. This was determined by a simple technique which was easily improvised in the laboratory as follows: Two tubes of potato-dextrose agar slants were inoculated as usual with bits of mycelium from the same culture used before. These tubes, with their cotton plugs removed, were inverted and placed separately into small milk bottles each containing two grams of dry pyrogallic acid. A small quantity of 5 per cent sodium hydroxide was poured into each bottle, to dissolve the pyrogallic acid. A sufficient amount of albolin oil was added to form a complete coating in the surface of the mixture. The pyrogallic acid was used to absorb the oxygen in the tubes.

Relations of acid and alkali (H-ion concentrations).—In order to determine the relation of growth of the fungus to the different hydrogen-ion concentrations, the fungus was grown in petri dishes of potato-dextrose agar with definite amounts of hydrochloric acid and sodium hydroxide.

In this work the method described by Karker and Webb (4) was employed. The writer is grateful to the latter for his personal aid in making hydrogen-ion determinations.

Since the fungus more adaptable to solid media than liquid media as used by the above authors, and since comparative growth of the thalli could be more conveniently measured, potato-dextrose agar was used as a medium and the procedure was as follows:

Potato-dextrose agar was made in the usual way, except that 900 c. c. of distilled water was used instead of 1,000 c. c. The reason for this change was that this method allowed dilutions of the various solutions by additions of regulated amounts of acid or alkali and water for the adjustment of various H-ion concentrations without affecting materially the concentrations of the nutrient salts or constituents (4).

When heated under pressure sugar reacts with acid or alkali, keeping the mixture from hardening. Hence, the acid, the alkali, and the above-mentioned medium were sterilized separately.

Forty-five cubic centimeters of the medium together with the desired amount of water were placed in each of a number of 150 c. c. flasks. These were plugged with cotton and sterilized in the autoclave for three successive days at seven pounds pressure for twenty minutes each day. The flasks were placed under the transfer hood, and then, by using sterile graduated

pipettes, definite amounts of N/1 hydrochloric acid and N/1 sodium hydroxide solutions were added as shown in the following table:

TABLE 5.—*Showing the amounts of water, acid, and alkali used*

No.	Medium	Distilled H_2O	N/1 HCl	N/1 H_aOH	Total Vol of culture.
	c. c.	c. c.	c. c.	c. c.	c. c.
1	45	....	5.0	....	50
2	45	0.5	4.5	....	50
3	45	1.0	4.0	....	50
4	45	1.5	3.5	....	50
5	45	2.0	3.0	....	50
6	45	2.5	2.5	....	50
7	45	3.0	2.0	....	50
8	45	3.5	1.5	....	50
9	45	4.0	1.0	....	50
10	45	4.25	0.75	....	50
11	45	4.50	0.50	....	50
12	45	4.75	0.25	....	50
13	45	5.00	....	....	50
14	45	4.75	....	0.25	50
15	45	4.50	....	0.50	50
16	45	4.25	....	0.75	50
17	45	4.00	....	1.0	50
18	45	3.5	....	1.5	50
19	45	3.0	....	2.0	50
20	45	2.5	....	2.5	50
21	45	2.0	....	3.0	50
22	45	1.5	....	3.5	50
23	45	1.0	....	4.0	50
24	45	0.5	....	4.5	50
25	45	....	....	5.0	50

Immediately after the acid or alkali was added the flask was shaken to mix the contents thoroughly. Duplicate sterile petri dishes were used, and 10 c. c. of this particular concentrations was put in each by means of a sterile 10 c. c. pipette. The remaining 30 c. c. of the solution was equally divided and placed in three test tubes. The tubes were quickly placed in a warm water bath (55° to 60°C.) and H-ion determinations were made according to the colorations colorimetric method of Clark and Lubs as follows:

To each of these test tubes the proper indicator was added, and the color which developed was compared with the colors obtained upon the addition of the quantities of standard buffer solutions which has been previously made.

The range in hydrogen-ion concentration obtained in these determinations was from pH 1.8 to 9.4.

A series plates was arranged from pH 1.8 to 9.4 and then each plate was inoculated in the center with bits of mycelium from a young culture. The plates were all kept at room temperature. Measurements of the increase in diameter of the thalli were taken daily for 10 days until the comparative results were obtained. The growth in duplicate plates of any particular

concentrations showed no wide difference, and the results reported in the table below represent the average of the 2 plates. A plate from each concentration was selected and the whole series was arranged and photographed as shown in Plate XIII.

TABLE 6.—*Showing the effect of acid and alkali upon the growth of M. parasiticum*

H-ion concentration	Diameter of colony (average of two plates) in mm.	H-ion concentration	Diameter of colony (average of two plates) in mm.
pH		pH	
2.2	Nil	4.6	82
2.4	Nil	6.4	57
2.8	25	6.6	43
3.0	61.5	6.8	25
3.4	28	7.0	18
4.4	86	7.2	Nil

From the results obtained it is obvious that the organism grew only in the acid range. It will be seen that little growth occurred at pH 2.8. Growth increased with the decrease of the hydrogen-ion concentration of the culture until at pH 4.4, where the fungus exhibited its maximum growth. Subsequently a rapid decrease occurred until growth was entirely inhibited at pH 7.2.

SPORE GERMINATION STUDIES

In this study tests were made of the spore germination of conidia from pure culture, and fresh conidia from the sporulating lesions of infected plants. These were treated under varied conditions.

Methods and technique.—All glassware was cleaned with cleaning solution, washed with running water, rinsed in distilled water, and then drained. Van Tieghem cells, filter papers, and cover slips were placed in petri dishes, wrapped with brown paper and then sterilized. The end of a pipette, for drawing spore suspension and liquid media, was inserted in a test-tube, fitted with cotton, and sterilized in the autoclave. This method is convenient for immediate use; otherwise, the pipettes were wrapped in brown paper and sterilized in the autoclave.

The methods and the technique employed in these studies were as follows:

1. A few drops of the liquid were placed in the bottom of each of the Van Tieghem cells partially filling the cells so as

to maintain a complete equilibrium of vapor pressure. A suspension of conidia was made in the same liquid, and a drop of this suspension transferred to each of the cover glasses, inverted over the Van Tieghem cells, and partially sealed with vaseline so as to prevent evaporation and to hold the cover glass in place.

2. For most purposes, especially when water was employed open drops of suspension placed on glass slides were conveniently and profitably used. The slides were placed in petri dishes lined with moistened filter paper. A drop of suspension was placed at either end of the slides. Two perforations were so made in the filter paper as to come directly below these drops. When necessary too rapid evaporation was prevented by moistening the filter paper with water from time to time.

3. In the case of solid media the spore suspension was applied either by spraying it over the surface of the hardened agar in the petri dish with a sterile pipette or by running a loopful of the spore suspension over the surface of the agar by means of a sterile platinum loop.

Germination in water.—Parallel experiments of the conidia were made with sterile distilled water, Mendota Lake water, and meteoric (rain) water. The conidia were placed in drops of water on the slides, and kept moist by the method described under number 2 above. The cultures were all kept in the laboratory at room temperature.

Results from these parallel tests showed no marked difference. Practically 100 per cent of the spores sown in each case germinated within 4 hours (Plate VIII, Fig. 3). Germination generally took place by the protrusion of germ tubes from any of the cells. The number of the germ tubes from each spore varied greatly. In a fully grown spore, 2 to 6 tubes were observed. These tubes gradually developed into hyaline, septate germ tubes which were filled with refractive contents. They formed branches which ramified and crossed one another.

Germination in liquid media.—The conidia were sown in various nutrient solutions, such as: (1) onion decoction (100 grams of onion scale together with 500 c. c. distilled water, steamed for one hour, filtered and sterilized); (2) onion leaf extract (fresh green onion leaves, crushed, placed in cheese cloth, and squeezed between the fingers); (3) onion scale extract, prepared as in (2) but not sterilized; (4) prune decoction; (5) nutrient broth; and (6) date decoction.

All the cultures were kept at room temperature. After five hours germination was observed in all the liquids, but the effects of these different decoctions germination were shown by the rapidity of growth.

TABLE 7.—*Spore germination in various nutrient solutions after 12 hours*

Decoction	Length of germ tubes in microns
Onion scale (boiled)	51 - 85
Onion leaf	93.5-136
Onion scale (not boiled)	([a])
Prune	93 -137.7
Nutrient broth	85 -103.7
Date	100 -110.5

[a] Few spores just starting to germinate.

With the exception of unboiled onion scale decoction germination occurred in all cases after 4 hours. After 12 hours there was only a slight budding in the boiled onion scale decoction (Plate VIII, Fig. 2), whereas practically 100 per cent germination occurred in all other cases. It will be seen, however, that very little difference, if any, was observed when germination occurred in favorable media.

Effect of desiccation.—Spore suspension from a vigorously sporulating 12-day-old culture of the fungus on potato-dextrose agar was prepared. A drop of the suspension was placed on each of the clean sterile glass slides and after the water was evaporated each slide was placed in a petri dish to prevent the accumulation of dust particles. At various intervals a thin film of sterile distilled water was applied to the spores, and the dish kept moist by wetting the filter paper below the slide, as described under method 2, page 31.

TABLE 8.—*Effect of Desiccation upon Spore Germination*

Period of desiccation	Percentage of germination	Period of desiccation	Percentage of germination
Hours		*Days*	
0	100	3	100
2	100	4	100
4	100	5	100
6	100	7	100
8	100	9	98
10	100	11	70
12	100	13	55
24	100	20	25
36	100	22	0
48	100	24	0

The above results show that the spores are sensitive to desiccation except when they remain in waxy masses on the host, and in moderate amount of nutrition in the culture.

Effect of freezing.—To determine the effect of freezing upon conidia, an abundantly sporulating 14 day-old culture of the fungus on potato-dextrose agar slant was placed out-of-doors on December 5, 1921 and left during the winter. The tube containing the culture was inserted into an inverted tube so as to protect the culture from the snow and rain. The entire device was placed in a wire basket tied against a wire fence in the yard. Germination tests were made from time to time. The last test made on April 3, 1922 showed that about 25 per cent of the conidia germinated. This indicates that the conidia are able to live over winter.

Effect of copper sulphate solution.—Bordeaux mixture is the most generally used fungicide, therefore an effort was made to test the effect of this fungicide upon spore germination. Since Bordeaux mixture holds in suspension solid particles which interfere with microscopic examinations, solutions of copper sulphate were used. It is known that copper sulphate is the principal constituent that gives Bordeaux mixture its effectiveness as a fungicide, hence tests were made to determine what concentrations of copper sulphate solutions were necessary to kill the spores. These tests would aid in furnishing practical information for field work.

The solutions of copper sulphate in distilled water were prepared as follows:

(1) 10 grams of copper sulphate crystals were dissolved in 100 c. c. of distilled water, making a 10 per cent stock solution of copper sulphate or 1 to 10 dilution.

(2) 1 c. c. of 1 added to 9 c. c. of distilled water equals 1 per cent or 1 to 100 dilution.

(3) 1 c. c. of 2 added to 9 c. c. of distilled water equals 0.1 per cent or 1 to 1,000 dilution.

(4) 1 c. c. of 3 added to 9 c. c. of distilled water equals 0.01 per cent or 1 to 10,000 dilution.

(5) 1 c. c. of 4 added to 9 c. c. of distilled water equals 1 to 100,000 dilution.

(6) 1 c. c. of 5 added to 9 c. c. of distilled water equals 1 to 1,000,000 dilution.

(7) 1 c. c. of 6 added to 9 c. c. of distilled water equals 1 to 10,000,000 dilution.

(8) 1 c. c. of 7 added to 9 c. c. of distilled water equals 1 to 100,000,000 dilution.

Inasmuch as the first two dilutions were known to be too strong for this experiment, only the last six dilutions were used.

These solutions were placed in test tubes, labeled, and fitted with rubber stoppers through each of which passed a glass rod drawn to a blunt point. Using Van Tieghem cells a few drops of the dilution to be used were placed in the bottom of the cells and on a sterile slide. A sufficient quantity of spores removed from a pure culture was sown into the drops on the slide and stirred so as to separate the spores to prevent adhering in masses. By means of a sterile platinum loop a drop of the suspension thus made was transferred to the cover glass and inverted on the Van Tieghem cell in the manner described under method 1, page 30. Duplicate cultures were made of each dilution and kept at room temperature. Water was used as a check. The results obtained were recorded as follows.

TABLE 9.—*Effect of copper sulphate solutions upon spore germination*

Dilution	Percentage of germination (average of two cultures)
1:1,000	Nil
1:10,000	Nil
1:100,000	Nil
1:1,000,000	50
1:10,000,000	90
1:100,000,000	100
Distilled water	100

From the above data it is obvious that germination occurred in dilutions 1:1,000,000; whereas, above this point the spores were killed. However, when this dilution was reduced the effect of copper sulphate was thereby entirely weakened, which rendered all the viable spores capable of germination.

It is evident, therefore, from the laboratory tests that the use of Bordeaux mixture as a spray will successfully check the disease.

PATHOGENECITY

In an investigation of this kind there are four requirements which are to be fulfilled in order to prove that the organism under consideration is the cause of the disease. These four rules—known as Koch's rules of proof—are: (1) constant association of the organism with the disease; (2) isolation of the organism from diseased tissue, and determination of cultural characters on various media; (3) inoculation of healthy hosts with the pure culture of the above isolation, and reproduction of the disease in characteristic form, checked by controls; (4) rediscovery of organism in inoculated, diseasesd plants, as

in (1), reisolation of the fungus and growth on the same media used in (2) to prove its identity with the original isolation.

The first of these requirements was complied with by the examination of numerous diseased onion plants in Madison, and in Racine, Wisconsin. The presence of the pathogene was observed by the abundance of conidia on the lesions produced. Microscopic examination of stained and unstained material of diseased tissue, as reported elsewhere in this paper, showed that the fungus in question was the only kind demonstrable in such tissues. Several series of isolations were made at different times from naturally diseased plants as heretofore described under "Original isolation, method 2," page . It was found that in all these isolations the same fungus was constantly associated with the lesions, thus proving the constant association of the pathogene with the leaf mold disease.

The original isolation and the cultural characteristics of the fungus are already described in the preceding pages under the caption "Physiology."

The last two of the above postulate were also complied with by the writer as described in detail in the paragraphs which follow:

INOCULATION AND REISOLATION EXPERIMENTS

Sources of inocula.—Mycelium, conidia, and ascospores were used as inocula. All the pure cultures of these were grown on potato-dextrose agar. The mycelina used were obtained from cultures of single-spore strains of conidia and ascospores. Where mycelium was used it was obtained from five to six-day-old culture or from colonies that had reached the size of 25 to 30 cm. in diameter, and conidia from ten to twelve-day-old cultures grown in petri dishes or tubes. The fresh conidia were taken from sporulating lesions of stems and leaves of naturally infected plants. The ascospores used for inoculation were obtained from the crushed perithecia which had been directly picked from overwintered stems and leaves. Conidia of ascospore strains which were obtained from pure cultures similarly isolated were used also for inoculation. The inoculum used is pointed out under each particular case.

Varieties of onions used.—The onions used were the common market onion varieties—white, red, yellow (*Allium cepa* L.), and "Egyptian onion" (*A. cepa* var. *bulbellifera*).

Methods and technique of inoculations.—The portions of the stems and leaves to be inoculated were wiped first with

absorbent cotton moistened with mercuric chloride solution (1–1000) and then with sterile water to remove the disinfectant. In most cases disinfection was entirely omitted; but the bloom—the white waxy or primrose covering on the surface of the leaves and stems—was first removed before inoculation because it prevents the spores from adhering to the surface of the parts of the plant to be inoculated. The inoculated plants were kept in moist chambers in order to retain a condition suitable for infection, and to prevent drying up of the inoculum. In the greenhouse the plants were kept under a wood framework, the sides of which were made of glass. In the field some plants were kept moist by means of a canvas spray chamber, while others were kept moist by wrapping the inoculated portions with moistened cotton, and then covering them with glacine bags. The spray chamber was made of unbleached muslin stretched over a frame 3½ feet wide, 6 feet long, and about 5 feet high at the ridge. At the middle of the pyramidal roof was placed a nozzle which was connected by a long hose to a faucet on a pipe line. A door on one side of the chamber made the examination of the inoculated plants possible at any time. These devices were removed after the first sign of infection became apparent. The viability of the spores was first tested before they were used. The mycelium was applied from the young cultures directly to the surface of the plants to be inoculated by removing bits of mycelium from the agar. Spore suspensions were prepared in sterile distilled water and were applied either by means of clean camel's hair brushes or as a spray by means of atomizers. In each infection experiment one or two plants were treated in a similar way except that no fungus was applied. Sterile distilled water was substituted in place of the fungus.

For convenience in recording, the inocula used were designated as follows:

Mycelium of single-spore conidium strain: MC.

Mycelium of single-spore ascospore strain: MA.

Conidia of single-spore conidium strain: C.

Conidia of single-spore ascospore strain: A.

Conidia from sporulating lesions of infected plants: CP.

Ascospores from perithecia of overwintered stems and leaves: AP.

Inoculations of 1920.—The first inoculation experiments were conducted in the greenhouse. Plants of common onions (white, red, and yellow varieties) grown in 6-inch garden pots (bulbs

planted November 30, 1920) were used in the experiment. On February 21, 1921 eighteen healthy plants of each variety were selected and treated as follows:

(1) Six plants, two young leaves and two lower leaves of each plant, were wounded at different portions and inoculated with bits of mycelium.

(2) Six plants, same as in (1), not wounded.

(3) Six plants, one-half treated as in (1), and one-half treated as in (2), but not inoculated, used as checks.

Of the inoculated plants two of each case were kept in moist chambers throughout the experiment; two were kept moist by wrapping the inoculated parts with cotton moistened with sterile water and then covered with glacine bags, and uncovered after 24 hours; and two were kept under ordinary greenhouse conditions. The check plants were subjected to similar conditions, but separated from the inoculated plants. All the plants were watered every other day.

Results.—Four days after inoculation, February 24, the inoculated young leaves showed the first sign of infection. Infection of the lower or older leaves became evident at a later date. The control plants remained healthy throughout the experiment, except two which were attacked by thrips. All the plants kept in moist condition were observed to have become infected. Of the plants kept under ordinary greenhouse condition only one white and one red took infection. The infected plants kept in moist chambers showed remarkable increase in the size of the lesions (Plate V). Those lesions which developed by inoculation at the middle of the young leaves measured an average size or six centrimeters in length and two centimeters in width after less than two weeks. In many instances the lesions developed rapidly lengthwise, involving the entire leaf. Conidia developed about five to six days after the lesions became visible.

The results obtained from these inoculations are shown in the following table:

TABLE 11.—*Results from inoculating with mycelium of single-spore conidium strain*

Variety	Number of leaves inoculated		Number of leaves infected	
	Wounded	Not wounded	Wounded	Not wounded
White	24	24	24	24
Red	24	24	14	13
Yellow	24	24	17	16

Reisolation of the fungus.—The leaves bearing sporulating lesions were brought into the laboratory and the organism isolated using the methods previously described. Microscopic examination of the conidia revealed characteristics similar to those of the conidia originally obtained from the naturally infected plants. When studied under the same conditions of nutrition as given the original cultures, these reisolated strains showed the same morphological characteristics and physiological behaviour as the original organism, *M. parasiticum.*

Reinoculations in the Summer of 1921.—In June and July, 1921, reinoculation experiments were conducted in the pathological garden. Two rows (Plate I) were grown from "Egyptian" bulbils, and likewise two rows each of white, yellow, and red varieties of market onions. Healthy, vigorous growing plants were selected. The inoculations were made upon "Egyptian" onion plants before and after the bulbils had appeared. Common market onions were also inoculated before and after the appearance of the umbels.

The plants selected were treated as shown below. For convenience every inoculated plant was tagged with a label bearing the number of the method of inoculation to which it belonged, together with the designation given the host plants and the fungus cultures. Thus Egyptian onion plants were marked "E," and the plants of the market onion varieties—white, yellow, and red—were marked "W," "Y," and "R," respectively. The plants inoculated under each were numbered 1, 2, 3, etc. The date of inoculation was indicated below these marks, with the inocula designated, as previously described; using this method a typical inoculated plant may be illustrated thus: $\frac{\text{E-MC-1}}{\text{7-24-21}}$. The history of this particular inoculation, is therefore, known in the record as,—Egyptian onion, Plant No. 1, inoculated with bits of mycelium of single spore, conidium strain, on July 24, 1921.

Using each of the inocula specified on page 256, six plants of each of the above mentioned varieties were inoculated. Three were wounded, and three not wounded. One or two plants were used as checks in each case.

Results.—The results obtained from inoculating the stem (seed-stalks) and leaves with mycelium and spores are repeated here in detail as follows:

FIRST INOCULATION

On June 2, 1921, twelve plants each of Egyptian and white onions were inoculated with mycelium. In each case one-half

of the plants were inoculated with pure cultures of the mycelium of single-spore conidium strain (MC), and the other half with pure cultures of the mycelium of single-ascospore strain (MA). When observed on June 6 all the plants that had been inoculated in the morning and kept in spray chamber had taken infection. Those plants inoculated late in the afternoon had shown infections practically in all the parts where the mycelium was applied. Not all the leaves and stalks of the plants inoculated in the morning and covered with glacine bags had developed infections. In some of the inoculated parts the inocula dried out before they had the change of producing infection. Subsequent observations of the plants were made. On June 17, the lesions had grown considerably. Up to this time from the first visible sign of infection, and average measurement of the lesions was four to five centimeters long and one to two centimeters wide. On June 27 the plants were badly diseased and showed the production of conidia. In severe cases the inoculated parts, especially near the tip, were girdled and thus bent down. A typical case is shown in Plate VII. All the check plants remained normal.

SECOND INOCULATION

On June 8, 1921, inoculations were made upon the plants of the red and yellow varieties in the same manner as in the first inoculation; using the same number of plants and the same kinds of inocula (MC and MA). On June 11 all the inoculated plants which were kept in spray chambers had shown infections, except one plant of the yellow variety which was inoculated with the mycelium of single-spore conidium strain (MC). None of the plants inoculated in the forenoon and covered with glacine bags showed infections. The plants inoculated in the late afternoon showed infections as follows: Of the white variety, two plants which were inoculated with the mycelium of the single-spore conidium strain (MC) had shown infections, and two which were inoculated with the mycelium of single-ascospore strain (MA) did not show any infection at all. Of the yellow variety only one plant which was inoculated with the mycelium of single-spore conidium strain (MC) showed signs of infection. Fifteen days later (June 26) these plants were again examined and it was found that the disease was not as severe as in the cases of the Egyptian and white varieties. None of the control plants had shown infections.

THIRD INOCULATION

On June 28, 1921, repeated inoculations, as in the first inoculation, were made upon other healthy plants of Egyptian and white varieties. This time pure cultures of conidia of single-spore conidium strain (C) and of single-ascospore strain (A) were sprayed on the plants as previously described. On July 3 all the inoculated plants showed the first visible signs of infection, except two plants of the Egyptian variety and one of the white variety which were inoculated in the forenoon with conidia of single-ascospore strain (A) and covered with glycine bags. Two weeks later (July 16) nearly all the leaves and seed-stalks, of those plants which were at first had shown sign of infections, had produced a considerable number of well-developed lesions. On July 25 these lesions were found to be covered with abundant black conidia and conidiophores. In some cases a continuous infection took place, that is, involving the entire length of the stem and leaves. Plate VI is representative of these cases. The check plants were all healthy, except one plant of Egyptian variety which showed evidence of infection. This plant was located near the diseased plants, and it is believed that the leaves bearing sporulating lesions of the diseased plant had come in contact with the leaves of the check plant and thus conidia were transferred to the latter.

FOURTH INOCULATION

On July 1, 1921, inoculations were made upon healthy onion plants of the red and yellow varieties. The same kinds of inocula were used as in the third inoculation. On July 7 observations of these inoculated plants were made and the following facts were noted: Of the plants of the red variety inoculated with conidia of single-conidium strain (C), two plants which were inoculated in the forenoon and covered with glacine bags, and one plant which was inoculated in the late atfernoon did not show any infections. Of those plants inoculated with conidia of single-ascospore strain (A), only two which were kept in spray chamber took infection. In the case of yellow variety, those inoculated with conidia of single-conidium strain (C), only two plants showed infections—one of those kept in spray chamber and one of those inoculated late in the afternoon. Of those inoculated with conidia of single-ascospore strain (A) only two showed symptoms of infection namely, those which were kept in the spray chamber. On July 14 few more characteristic spots had developed on the stems and leaves. On well developed lesions conidia and conidiaphores were produced. All the check plants continued to develop normally.

FIFTH INOCULATION

On July 25, 1921, inoculations were made again using plants of Egyptian and white varieties. This series of inoculations differs from the preceding in that these later inoculations were made just at the time when the stalks were beginning to show the formation of the bulbils. Furthermore, different inocula were used, namely, fresh conidia (CP) from sporulating lesions of the infected plants and ascospores from perithecia of over-wintered materials. On July 30 all the Egyptian plants inoculated with fresh conidia (CP) had developed the characteristic lesions. It was noted, however, that only one or two leaves, and in some cases only the stalks, of those inoculated in the forenoon and covered with glacine bags showed signs of infection. Of those inoculated with ascospores only two plants were not infected. Practically the same results were noted in the case of the white variety. On August 19 a large number of infections was observed. None of the control plants had shown any evidence of infection.

SIXTH INOCULATION

On July 31, 1921, the last series of inoculations was accomplished in the same manner as in the fifth inoculation, that is, by employing the same kinds of inocula, but using plants of the red and the white varieties. Observations made on August 6 revealed the following results: Of the plants of the red variety inoculated with fresh conidia (CP) only two which were inoculated in the forenoon and covered with glacine bags had not produced infections. However, of those inoculated with ascospores only one plant which was kept in the spray chamber showed a few characteristic lesions. Subsequent observations were made, but no new marked developments of infection were note. Check plants were normal. Less infection occurred in the case of the plants of the yellow variety. Of the six plants inoculated with fresh conidia (CP) two which had been kept in spray chamber showed only a few leaf and stalks infection; two inoculated in the forenoon and covered with glacine bags showed no infection; and of the other two plants inoculated late in the afternoon only one plant showed infections which were on two leaves and near the tip of the flowering stalk. Of the other set of six plants inoculated with ascospores (AP) only one plant which was kept in spray chamber showed incipient lesions. A few identical lesions developed at a much later date. The last observation of the infected plants was made on August 22 when the lesions had, in some cases, developed considerably and were covered with conidia. The check plants remained healthy.

These results indicate that the different kinds of inocula used were equally infectious.

Inoculations made in the forenoon failed to produce infections in most cases; whereas, those made late in the afternoon, and those kept moist, were successful.

Infections took place in both injured and uninjured tissues.

Infections were also produced in any aërial part of the plant, leaves and stalks. But infections in the older tissues were not as disastrous as in the younger tissues.

The red and yellow varieties were less susceptible than the Egyptian and white varieties.

A comparative report of the results detailed above is given in the following table:

TABLE 12.—*Results of inoculating mycelium and spores*

Variety name	Inoculum	Number of plants inoculated		Number of plants infected	
		Wounded	Not wounded	Wounded	Not wounded
Egyptian	PURE CULTURES				
	MC	3	3	3	3
	MA	3	3	3	3
	C	3	3	3	3
	A	3	3	2	2
	FRESH SPORES				
	CP	3	3	3	3
	AP	3	3	2	2
White	PURE CULTURES				
	MC	3	3	3	3
	MA	3	3	3	3
	C	3	3	3	3
	A	3	3	2	2
	FRESH SPORES				
	CP	3	3	3	3
	AP	3	3	2	2
Red	PURE CULTURES				
	MC	3	3	2	2
	MA	3	3	1	1
	C	3	3	2	1
	A	3	3	1	1
	FRESH SPORES				
	CP	3	3	2	2
	AP	3	3	1	0
Yellow	PURE CULTURES				
	MC	3	3	1	1
	MA	3	3	1	1
	C	3	3	1	1
	A	3	3	1	1
	FRESH SPORES				
	CP	3	3	2	1
	AP	3	3	1	0

GENERAL DISCUSSION OF RESULTS WITH REFERENCE TO PARASITISM

It is obvious from the results obtained that when mycelium was the source of inoculum, infection took place very rapidly, usually from three to four days after inoculation. The size of the lesions vary considerably, within two weeks time the average size of the lesions bearing conidia was 1 × 5 cm. In several instances the lesion grows longitudinally involving the whole length of the stems or leaves towards the tips, and killing and turning the diseased tissue into yellow brown. Infection from conidia occurred in four to six days, and more readily when plants were kept moist by means of moist chambers for about twenty-four hours after inoculations. A very high percentage of the plants inoculated showed infection. In the field successful results were obtained when the inocula were placed on the leaves and stems in the late afternoon. This is explained by the well-known fact that infection occurs almost entirely during the night or in dull damp weather when the vital activity of the plant is somewhat checked, due to the turgidity of the cells as a result of retarded transpiration and respiration. In this condition there is an accumulation of the so-called chemotactic substances in the cell sap of the stems and leaves, a circumstance which favors infection. While this condition, indeed expose the host plant to rapid infection, it must be added that this same condition is most favorable for the development of the pathogene.

Whether mycelium or conidia were used as inoculum and whether the host plant was injured or uninjured, apparent positive infection resulted. Pure cultures of conidia produced from single ascospores of this fungus, as well as fresh ascospores, when used as inocula also gave positive results of infection. Thus parasitism of the fungus under consideration is demonstrated by the infections brought about by numerous and repeated inoculations with both pure cultures and fresh ascospores of the organism. All the varieties of onions inoculated were affected, except that Egyptian and white onions are more susceptible to the disease than the red and yellow varieties.

PATHOLOGICAL HISTOLOGY

RELATION OF THE CAUSAL ORGANISM TO THE HOST TISSUE

Naturally infected tissues of the onion plants (leaves and stems), when examined microscopically at the various stages of the disease, were found to be penetrated by the fungus mycelium which gave rise to serveral hyphæ-bearing conidia.

In order to determine the exact relation of the fungus to the internal tissues of the host plant the following studies were made.

Histological methods and technique.—For the study of penetration, spore suspension from pure culture was prepared in a sterile distilled water blank in a test tube. This inoculum was applied, either by means of a camel's hair brush or in drops by means of a platinum loop, to the various parts of the uninjured surface of both young and older leaves of a vigorously growing onion plant in the greenhouse. The white waxy material (bloom) on the surface of the onion was first removed by wiping with moistened absorbent cotton, in order to make the spores adhere to the surface of the plant to be treated. The inoculated parts were ringed with India ink, and, at various intervals, the leaves were removed from the plant and an examination was made. Thin strips of the epidermis below the infected area were removed by means of the tip of the needle, plunged in 95 per cent alcohol for a few minutes, and then stained with Pianese stain according to the following schedule which was a slight modification of Professor Vaughan's method.

1. Stained with Pianese stain for about ten minutes (or so).
2. Destained with equal parts of 95 per cent alcohol and acetic acid.
3. Washed in absolute alcohol.
4. Cleared in carbol turpentine (turpentine 3 parts and melted carbolic acid crystals 2 parts).
5. Washed in xylol.
6. Mounted in balsam.

The whole process was satisfactorily accomplished on the slide. The strip of epidermis was directly placed on the slide to be sure that the outer surface was on top of the preparation.

The fungus was differentiated from the host which remained slightly stained or practically unstained in most preparations. The germ tubes or mycelia were bright red in the final preparation and could be traced distinctly under the microscope.

For the study of the relation of the fungus to the host tissue following penetration, inoculated stems and leaves as well as naturally infected plants in the fields were used. Small blocks of the lesions were cut from the material and fixed in Gilson's, Flemming's, and chrome-acetic fluids, washed, dehydrated, embedded in paraffin, and sectioned with the rotary microtome five to seven microns in thickness. The differentiation of the

fungus from the host was made by using various stains such as Flemming's triple, Durand's hæmatoxylin-eosin, and Haidenhain's iron alum hæmatoxylin. In this work Gilson's fixative and Flemming's triple stain seemed to be the most satisfactory combination.

Penetration.—From 24 to 48 hours after inoculation, when conditions were favorable for the rapid germination of spores, penetration of the fungus into the host tissue was observed. In all the preparations examined the germ tubes were found to penetrate through the stomata (Plate XVIII). Not a single preparation showed a sign of direct penetration through the cuticle.

Subsequent penetration and effect on the host tissue.—The infecting hyphæ of the fungus passed between the guard cells down into the stomatal chamber two to three days after inoculation. This condition is shown in Plate XIX, Fig. 1. From the stomal chamber the fungus made its way into the interior tissues of the host. At this stage, before the host cells were destroyed, the relation of the mycelium to the parenchyma cells was usually intercellular. Later in the development of the fungus, that is in the older lesions, the hyphæ penetrated the deepest tissues. The extent of this invasion is illustrated in Plate XIX, Fig. 2. At this stage the mycelium was not only intercellular but also penetrated into the cells. The protoplasm of the cells was then gone. The cells collapsed followed by the entire disorganization of the cell contents, and the affected area produced a depressed lesion which could be seen on the outer surface of the host. The vascular bundles were almost entirely affected, and the xylem and phloem, in several preparations, were seen to be entirely destroyed. Some of the vessels (tracheæ) were clogged with mycelium. As the fungus became firmly established, the vegetative mycelium was found in the epidermal cells. Here it produced aërial hyphæ or conidiophores which broke through the ruptured cuticle into the outside air. These hyphæ gave rise to conidia.

Preparations made from old infected stems and leaves showed a remarkable decomposition of the inner tissue so that it is often impossible to demonstrate the relation of the mycelium to the invaded tissues. Plate XX which is a cross section of an infected stem is typical of this condition. The mycelium was found to pass through the stomata and through the ruptured epidermis sending out hyphæ. The number of the hyphæ depends upon the size of the opening of the cuticle and

of the stomata through which they emerge, generally in clusters of two or three.

LIFE HISTORY OF THE CAUSAL ORGANISM IN RELATION TO PATHOGENESIS

SEASONAL DEVELOPMENT OF THE DISEASE

The disease has been reported as occurring in Louisiana year after year.

Lesions on the stems and leaves of the Egyptian onion produced by *Macrosporium parasiticum* become visible about the time that the bulbils are becoming evident. Lesions were observed on plants grown in some of the fields visited by the writer at Madison, Wisconsin. The fungus appears on these lesions as a black velvety coating due to the presence of conidia. They are particularly abundant during the months of July and August. As the season progresses the lesions rapidly become enlarged, generally involving the entire portion, leaves or stalks, surrounding the seat of infection.

CLIMATIC CONDITIONS IN RELATION TO THE DEVELOPMENT OF THE DISEASE

The fungus grows best under warm, moist conditions. The weather and climatic conditions as related to the development of the disease have been reported by Edgerton (2d), who observed the differences in the development of the disease in Louisiana, particularly between the localities of Bayou Lafourche and at Batan Rouge. He says:

"The lower part of Bayou Lafourche, where most of the onions are grown, is not far from the Gulf. The rainfall is heavy and humidity is high. Heavy fogs are very common during the early spring season. Furthermore, the soil is heavy and the drainage is not of the best. Baton Rouge is farther away from the Gulf and on higher ground. The fogs are not nearly as frequent and the humidity averages slightly lower."

The disease is particularly severe in the Bayou Lafourche region causing considerable damage to the seed crop every year. Apparently the fungus thrive better in the Bayou Lafourche region than it does in the higher land at Baton Rouge.

In Wisconsin the disease is severe during the moist, warm weather of late spring and early summer. It appears to be most severe towards the end of the latter season.

PRODUCTION OF SPORES

Under favorable conditions of warm and moist weather, there is abundant production of conidia upon well developed lesions of onion plans in the field, appearing as macroscopic black masses. In some instances sporulation is scarcely evident in the early stage of infection. However, sporulation continues throughout the development of the lesions. As has been stated before it is most plentiful in July and August and diminishes towards the early part of fall.

Lesions which develop upon the tissue of artificially inoculated plants, as well as those in moist chambers in the laboratory, produce conidia. Perithecia have been observed upon the infected plants during the growing season, and they are also abundantly found in the spring upon overwintered stems and leaves.

In artificial media culture of the fungus rarely produce conidia. Mycelial growth obtained from plating small pieces of the lesion does not produce conidia unless the growing mycelium is injured. Likewise, subsequent cultures of the mycelium from single-spore isolations do not produce conidia. As has been indicated elsewhere in this paper, attempts to grow the fungus on different substrata from aforementioned sources with the aims of producing conidia and perithecia were unsuccessful.

Experiments on the relations of temperature as well as the relations of hydrogen-ion concentration (variation of acid and alkali) gave the same unsuccessful results. However, single conidia isolated in the manner previously described and grown on potato-dextrose agar slants or plates developed conidia, and as has been stated, subsequent cultures of the mycelium do not produce conidia; whereas continued cultures of the conidia always give sporulation. It appears, therefore, that the age of the cultures bears a relation to the production of spores. It was thought in this connection that there might be discovered some sporulating strains which could maintain continuous sporulation regardless of several generations of vegetative (mycelial) cultures. Several strains of conidia were isolated and subsequent cultures were made from the conidia and mycelia produced. The results of such cultures seem to verify the above conclusion; namely, that subsequent cultures of mycelium only give vegetative growth.

Rands(8) has found that by severely wounding the mycelium, abundant sporulation could be produced. Accordingly, the fungus was grown on hard potato-dextrose agar in eight petri dishes. When the colony on each dish had reached the size of about thirty to forty millimeters in diameter, four of the dishes were treated by removing two or three strips of agar cut through the colony. The other four plates were left undisturbed. The plates were divided into two sets, each set being composed of two treated and two untreated plates. Each set was kept in a separate sterilized chamber (a large dish), with the covers of the petri dishes removed so as to expose the cultures and thus permit rapid evaporation of water from the exposed surface of the agar. A small thermometer was placed in glass chamber. One set was placed under a desk lamp thus securing a constant temperature of 30° C. inside the chamber, and the other set was placed on the desk receiving the diffuse light of the laboratory, the temperature being about 24° C. All these cultures, whether the mycelium had been wounded or not, gave abundant sporulation. Microscopic examination showed that, from the cut edges of the colony branches of mycelium which gave rise to slender hyphæ bearing conidia grew against the wall of the petri dish in the manner shown in Plates XIV and XV. The formation of perithecia on the mycelium also took place in the manner shown in Plates XVI and XVII. The sporulation on the surface of the uninjured colonies was sometimes characterized by the concentric layers of the masses of conidia.

Inasmuch as experiments with the relations of light and different temperatures showed very little if any sporulation even at the optimum temperature where vegetative mycelium grows vigorously, it seems fair to conclude that partial drying of the medium (assisted by high temperature) is the determining factor for the abundant sporulation. The fact that warm weather is favorable for the abundant sporulation in nature may perhaps account for the above phenomenon.

VIABILITY AND LONGEVITY OF SPORES

The writer has previously shown that spores which had been allowed to desiccate on glass slides gave a very low percentage of germination after 13 days and no germination at all after 24 days. However, spores obtained from potato-dextrose agar culture prepared July 27, 1921, gave little germination. Tests were also made of the viability and longevity of conidia which developed on the lesions of the host plant. Leaves and stems

of diseased onion bearing conidia were collected and kept in a box in the laboratory. Germination tests of the conidia were made from this material from time to time. The results of such tests showed that practically little or no germination occurred after two months. It is obvious that the results thus obtained from these three lines of investigations, point to the following conclusions: (1) that conidia are sensitive to desiccation when separated from the waxy masses on the host; (2) that under dry conditions only a small percentage remain viable on the host for a short time; and (3) that with a moderate amount of nutrition in the culture they could maintain life longer.

DISSEMINATION OF CONIDIA

Inasmuch as the connection between the conidia and hyphæ is slight, it is believed that the former can be easily dislodged by the wind. This was determined by smearing glycerine on the bottom of a petri dish placed at a convenient distance from infected plants bearing conidia, and then aspirating a current of air from a small bicycle pump over the infected plants toward the dish for a few seconds. When the dish was examined a multitude of conidia was present. Again, a dish was placed under the low power of the microscope in such a way that the cut edge of the colony showing fructification, as described elsewhere, could be observed. When a current of air was blown over this material the spores were detached from the hyphæ.

Since warm, rainy weather is favorable for the development of the disease, and since high humidity induces the production of conidia, it seems reasonably certain that conidia are also disseminated by meteoric rain drops. Spores may be washed from the plant to the soil whence they are carried by the wind in dust particles to other plants.

It was mentioned under "Production of Spores" that spores were produced along the edges of the cut colony on the agar plate. When water was run along the cut furrows where sporulation occurred against the wall of the petri dish and examined under the microscope, detached conidia were observed floating in the water. When a dish culture showing abundant sporulation was inverted over another dish of hardened agar and then gently sprayed with distilled water by means of an atomizer, the shower that passed over the culture and fell upon the surface of the hardened agar brought myriads of conidia.

From the above results it is conceivable that the conidia are readily disseminated by both rain and wind.

OVERWINTERING OF THE FUNGUS

The results of the experiment, already reported, on the effect of freezing on conidia have indicated that conidia are able to survive in the winter. The possibility for the perpetuation of the fungus therefore is through the mycelium and the conidia. To ascertain definitely the possibility of the former, stems and leaves of onions were inoculated with bits of mycelium, allowed to take infection in the greenhouse, and then placed out-of-doors. Likewise, two potato-dextrose agar slants showing abundant mycelial growth were placed outside on December 5, 1921. These materials were kept in a fairly secured container to protect them from snow and rain. On April 3, 1922, fragments from each of the above materials were plated out on potato-dextrose agar. Good growth was shown in both cases.

The results of such experiments substantiated with field observations show that the fungus overwinters in its mycelial stage and produces conidia and perithecia in the spring.

SOURCES OF NATURAL INFECTION

It has been mentioned above that the fungus survives in the winter as mycelium and that conidia and perithecia are produced in the spring. It is, therefore, easy to see that conidia and ascospores initiate the primary infection. The conidia from the lesions produced during the growing season constitute the source of secondary infection. In an infected patch of onions the stems and leaves of infected plants come in contact with the uninfected plants and thus the conidia are transferred resulting in new or secondary infection. During favorable weather for spore dissemination secondary infections are expected to be worst.

METHOD OF INFECTION

Repeated artificial inoculations showed that the fungus is able to produce infection both in the absence and presence of a wound. However, penetration studies indicate that the fungus penetrates the host tissue only through the stomata.

PERIOD OF INCUBATION

The infection courts may be any portion of the aërial parts (stems and leaves) of the plant. Conidia carried to these parts by the wind or by spattering rain germinate readily. The so-called period of incubation or the time which elapses between infection and the first macroscopic evidence of the appearance of the lesions varies according to the kinds of inocula

used. Inoculation experiments showed that conidia placed on the wet surfaces of sound onion leaves and stems produced visible lesions from four to six days. On the other hand inoculations by means of mycelium resulted in infections in a shorter period.

CONTROL MEASURES

No control measures have ever been worked out by the writer. Consideration of the pathogene, however, seems to indicate that prevention rather than curative measures is the best prospect of eliminating the disease. Since the fungus is perpetuated over winter by means of mycelium which survive in the dead tissues of leaves and stems of onions, it is of first importance to burn all such refuse. Spraying with Bordeaux mixture is probably the next best means of control.

The Louisiana Experiment Station (2d) is trying the effect of the latter. But since it is necessary to spray the plants once a week, it seems doubtful whether the yield from sprayed plots would pay the expenses incurred thereby.

SUMMARY

Leaf mold has long been recognized a disease which affects the stems and leaves of the common onion (*Allium cepa* L.) and the "Egyptian onion" (*A. cepa,* var. *bulbellifera*).

The distribution of the disease has been reported as occurring in Massachusetts, Louisiana, Ohio, Washington, Rhode Islands, Connecticut, New York, Indiana, Michigan, and Utah. It is believed that the disease occurs wherever the onion is cultivated.

The disease first appears as small white sunken spots, which gradually enlarge into depressed linear lesions. These lesions become deep and velvety in appearance due to the formation of black masses of conidia.

The disease, formerly considered of minor importance, has become destructive in recent years. It has been reported that the disease causes considerable damage in Louisiana every year. According to Edgerton, the disease together with the downy mildew decreased the seed crop in Louisiana about 50 per cent in 1921.

The disease is caused by a fungus, the conidial stage of which has long been known as *Macrosporium parasiticum,* which was named and described by von Thümen in 1887. Miyabe, in 1890, had definitely and conclusively shown that *Macrosporium parasiticum* is identical with *M. sarcinula,* of Berkeley, which the

latter author named and described in 1837. The ascigerous stage, *Pleospora herbarum,* was first named by Persoon as *Sphaeria herbarum,* but was later changed into *Pleospora herbarum* by Rabenhorts, who gave a complete description of this form. Miyabe has also established the fact that *Macrosporium parasiticum* is genetically connected with *Pleospora herbarum,* a fact which is in complete harmony with the observation of the writer.

The morphology of both the conidial and ascigerous forms of the parasite is given. The essential diagnostic characteristics of the conidial form are the compound muriform, oblong-obovate to depressed-rotundate, always rounded at both ends, dark brown conidia with numerous short projections on their thick walls. These conidia are borne on the swollen tips of the hyphæ which are simple, septate, and sometimes branched, arising from the mycelium. The ascigerous form is characterized by the spherical perithecia containing slender, septate paraphyses and cylindrical oblong asci, each containing eight yellowish brown muriform ascospores.

Pure cultures of the causal organism are readily obtained by any of the three methods used, namely: (1) plating on agar medium small fragments of incipient lesions, about 80 per cent gave a pure culture of the same fungus; (2) single-spore isolation; and (3) transferring into agar medium tufts of conidia from sporulating lesions on stems and leaves.

The fungus was grown upon more than 20 different artificial and natural media. The fungus grew well upon this wide range of media. The characteristics of growth of the fungus in some of these media are described.

The minimum temperature for growth on a favorable substratum, potato-dextrose agar, is about 4° C., the optimum about 20° to 23° C,. and the maximum about 35° C.

Although sufficient moisture favors vegetation growth, the mycelium of the fungus could withstand long desiccation.

Light exerted no marked influence upon the vegetative growth of the fungus.

The fungus is sensitive to varying amount of oxygen. Its growth is entirely inhibited in the absence of free oxygen.

The organism grew only in the acid range. The growth of the fungus seemed to be inhibited above pH 2.8 below pH 7.0. The maximum growth occurred at pH 4.4.

Spore germination tests in the laboratory show that as soon as the conidia are mature they germinate readily in sterile water, distilled water, rain water, and in a large variety of nutrient decoctions and agar media. Germination in these cultures occurs from four to six hours.

Conidia germinate slowly in boiled onion scale, but are practically inhibited in onion-scale extract which has not been previously boiled.

Owing to their thick walls the conidia can withstand desiccation on the glass slides for several days. The conidia which remained in waxy masses on the host and in agar cultures maintained their life for several months—a condition which accounts for the viability of the spores through extended unfavorable wheather.

Conidia withstand freezing temperatures.

Spore germination in copper sulphate solutions occurred in dilution 1 to 1,000,000, whereas at a higher concentration the spores were killed.

Macrosporium parasiticum has generally been considered a secondary parasite to onion mildew, and has therefore been considered incapable of independently infecting the onion. In Wisconsin, where mildew seldom occurs, *M. parasiticum* is found depeatedly, apparently causing distinct lesions on leaves and seed stems of onion, and often girlding the latter.

Experiments were undertaken to determine the pathogenecity of the organism.

Greenhouse inoculations were made with mycelium from young cultures, applied through wounds or directly to the uninjured tissue. Characteristic symptoms of the disease were produced in both cases.

Inoculations in the field with mycelium and with suspension of conidia and ascospores also yielded positive results.

Infection occurred more readily when plants were kept moist for a short time after inoculation by means of moist chambers.

Reisolations were made from a number of these plants. These resulted in a fungus growth similar to the one originally obtained from the naturally infected plants.

Reinoculations by means of the reisolated cultures of the fungus gave the same positive results as before.

Pure cultures obtained from single ascospores of this fungus have produced typical conidia and positive results of infection using such conidia have been obtained.

Results therefore indicate that the fungus is capable of acting dependently as an aggressive parasite.

No experiments were performed regarding the pathogenecity of *Pleospora herbarum* on other host plants, but Miyabe mentioned that certain investigators had found this organism to be parasitic on other plants. According to him Spergazzini found this fungus on the living leaves of grape-vine and *Medicago sativa;* Cugini and Passerini on living branches of mulberry trees; Berlese on living branches of *Sambucus nigrai;* and Linde, in roots of clover.

Histological studies have shown that the only mode of penetration of the host tissue by conidia germ tubes is only through the stomata. Subsequent development of the fungus reveals the fact that it is both inter-and intracellular in nature: the hyphæ penertate into the cells as wells as between them.

Warm moist weather favors the development of the disease.

Conidia are abundant in nature upon well developed lesions of infected onions. They are not readily produced in culture unless the mycelium is injured or the plate cultures are allowed to partially desiccate.

Conidia are disseminated by means of wind and meteoric water in the form of spattering rain.

Hibernation of the fungus is by means of the mycelium and conidia which live over winter in the dry stems and leaves left on the ground. Infection originates from these and produces primary lesions on growing new plants.

The mycelium, therefore, as well as conidia which have survived during the winter, and the ascospores produced in spring also initiate primary infection. The conidia from the lesions produced during the growing season constitute the source of secondary infection.

Repeated artificial inoculations show that the fungus is able to produce infection both in the absence or presence of wounds. The method of infection is through stomata.

The period of incubation varies with the different inocula. Conidia placed on the sound onion leaves or stems produced visible lesions within four to six days. Infection resulted from the mycelium inoculum in a shorter period.

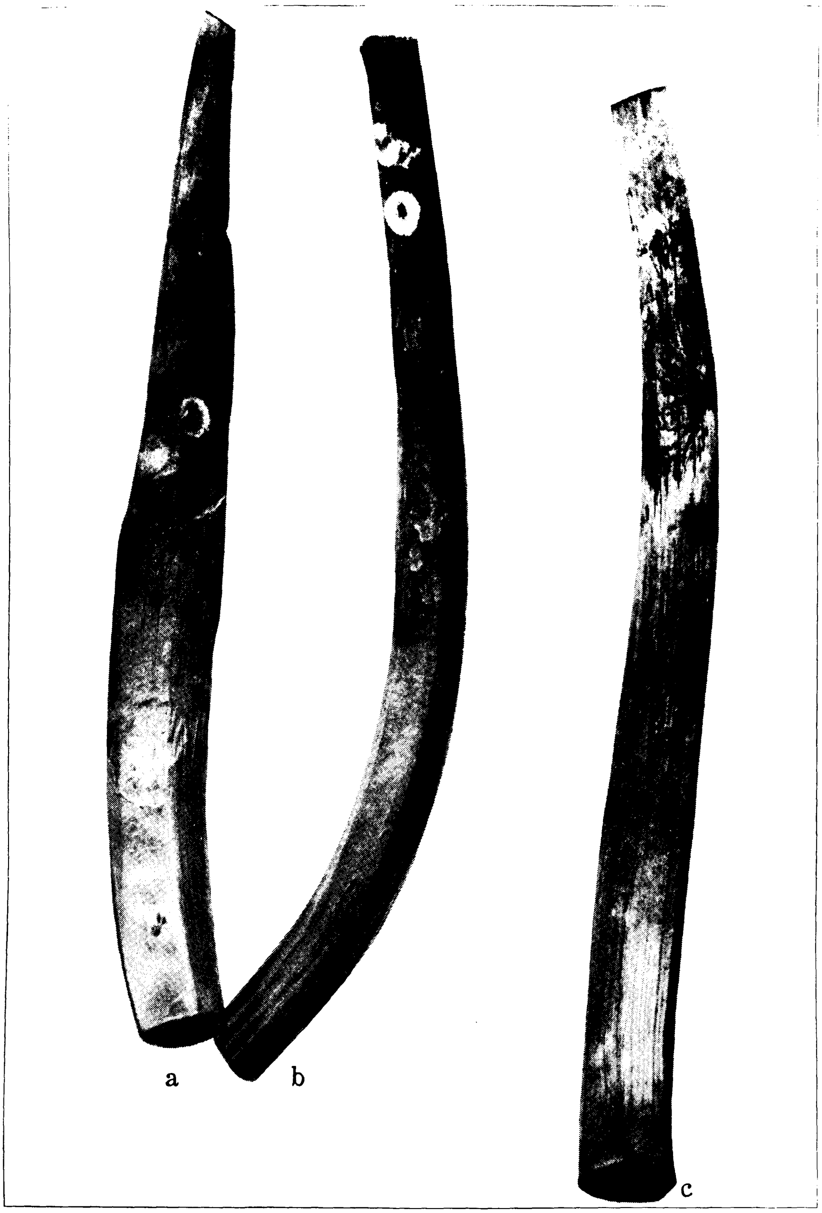
Although no control measures have ever been worked out, it is believed, from the consideration of the pathogene, that the removal and destruction of diseased plants and dead tissue of leaves and stems of onion is probably the only advisable way of controlling the disease.

Two rows of "Egyptian onion" (*Allium cepa*, var. *bulbellifera*), planted from bulbils in the spring of 1920, allowed to remain in the ground over winter. These plants furnished materials for inoculations in the following spring. Photographed April 29, 1922. Stalks bearing the clusters of bulbils are not yet formed.

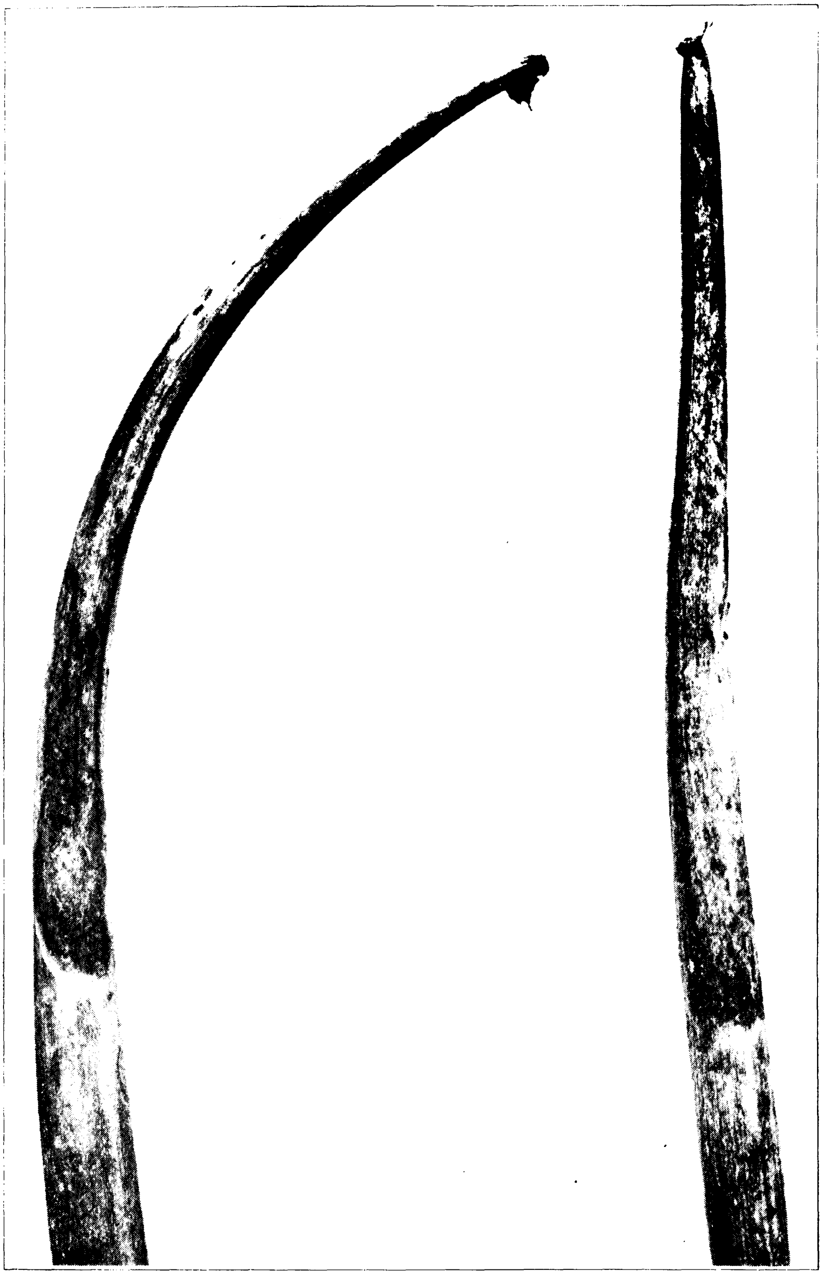
Two rows of "Egyptian onion" (*Allium cepa*, var. *bulbellifera*), planted from bulbils in the spring of 1920, allowed to remain in the ground over winter. These plants furnished materials for inoculations in the following spring. Photographed April 29, 1922. Stalks bearing the clusters of bulbils are not yet formed.

Seed stalks of common onion (*Allium cepa* L.) attacked with *Macrosporium parasiticum*. Note the black velvety coating which involves the entire stalk and the production of perithecial bodies. The last three flower-stalks were cut off by the invasion of the disease.

Photograph of a portion of the stem of overwintered seed stalk of "Egyptian onion" collected in the spring, showing matured perithecia.



Inoculated leaves of white variety of *Allium cepa* grown in the greenhouse: (*a*) and (*b*) inoculated with spore suspension from 12-day-old potato dextrose agar culture of conidia strain, and (*c*) similarly inoculated with ascospore strain. Photographed six days after inoculation.



Two stalks of *Allium cepa*, var. *bulbellifera* grown in the pathological garden, inoculated with spore suspension from 12-day-old culture of conidia strain. Photographed two weeks after inoculation.

Allium cepa, var. *bulbellifera* growing in the pathological garden, inoculated with bits of mycelium from 5-day-old culture. Note the girdled condition of the inoculated part (*x*). Photographed 10 days after inoculation.

The application of Bordeaux mixture seems to check the disease, but the cost of spraying, as has been figured out by the Louisiana Experiment Station, does not warrant the use of this fungicide.

LITERATURE CITED

1. COONS, G. H. Factors involved in the growth and pycnidia formation of *Plenodomus fuscomaculous*. *In* Jour. Agr. Res. vol. 5, pt. 2, no. 16, p. 713–769. 1916.
2. (*a*) EDGERTON, C. W. Stem rot, caused by *M. sarcinula*. *In* U. S. A. D. Bur. Pl. Ind. Plt. Dis. Bul. vol. 3, no. 5, 67. 1919.
   (*b*) —— Black mold, caused by Macrosporium sp. Ibid. vol. 4, no. 6, p. 94. 1920.
   (*c*) —— Macrosporium disease. Ibid. vol 5, no. 2, p. 36. 1921.
   (*d*) —— Onion diseases and onion seed production. La. Agr. Exp. Sta. Bul. 182, p. 1-20, fig. 1-9. 1921.
3. HASKEL, R. J. and MARTIN, G. H. Leaf blight caused by macrosporium sp. *In* U. S. D. A. Bur. Pl. Ind. Supplement 2 (1918) p. 81. 1919.
4. KARRER, J. L. and WEBB, R. W. Titration curves of certain liquid culture media. *In* Annals of the Missouri Botanical Garden vol. 7, p. 299–305. 1920.
5. KEITT, G. W. Simple technique for isolating single spore strains of certain types of fungi. *In* Phytopathology vol. 5, no. 5, p. 266–267. fig. 1. 1915.
6. MIYABE, KINGO. On the life history of macrosporium parasiticum Thum. *In* Annals of Botany vol. 3, p. 3-26. 1889-90.
7. PERSOON. Sphaeria herbarum on Allium cepa in Wartmaun and Schenk, Schweiz, Krypt. no. 322 (or Synopsis Methodica Fungorum, p. 79.)
8. RANDS, R. D. The production of spores by *Alternaria solani* in pure culture. *In* Phytopathology, vol. 7, no. 4, p. 316-317. 1917.
9. SACCARDO, P. Sylloge Fungorum, p. 247, 2. Patavii. 1883.
10. SHIPLEY, ARTHUR E. Kew Bulletin of Miscellaneous Information no. 10 Oct. (also in Proc. Camb. Phil. Society, vol. VI, Part 3). 1887.
11. THAXTER, ROLAND. Reprot of Mycologist. *In* Conn. Agr. Exp. Sta. Ann. Rpt. (1889) p. 158–162. 1890.
12. THÜMEN, F. DE. Mycotheca Universalis, Cent. VII, N. 667, Klosterneuburg. 1887.
13. TULASNE, C. and L. R. Selecta fungurum carpologia tom. 11, p. 263. tab. XXXII, fig. 6. 1863.

199818——4

Plate VIII

All drawings made under Zeiss 6 mm. apochromatic objective with No. 4 compensating ocular, and with the aid of Abbe-camera lucida.

FIG 1. Matured conidia from 12-day-old potato destrose agar culture.

2. Conidia germinating in onion scale decoction after 12 hours.
3. Conidia germinating in distilled water.
4. Mycelium growing in onion leaf decoction in Van Tiebhem cell.
5. (*a*) and (*b*) young fertile hyphae before abstriction; (*c*) a very young spore formed at the tip of conidiophore; (*d*) and old fertile hypha, showing the growth of new hypha, which arises not from the swollen cell but from the cell below, and grows through the middle of the older piercing the wall at its tip; (*e*) a common form of hypha seen in potato dextrose agar culture; (*f*) an old hypha which has shed its spores, its upper wall has collapsed and assumes a characteristic cup-shaped form; (*g*) a mode of formation observed in early culture; (*h*)-(*k*) common forms seen in pure cultures, (*h*) and (*j*) younger stages; (*l*) and (*m*) observed in distilled water.

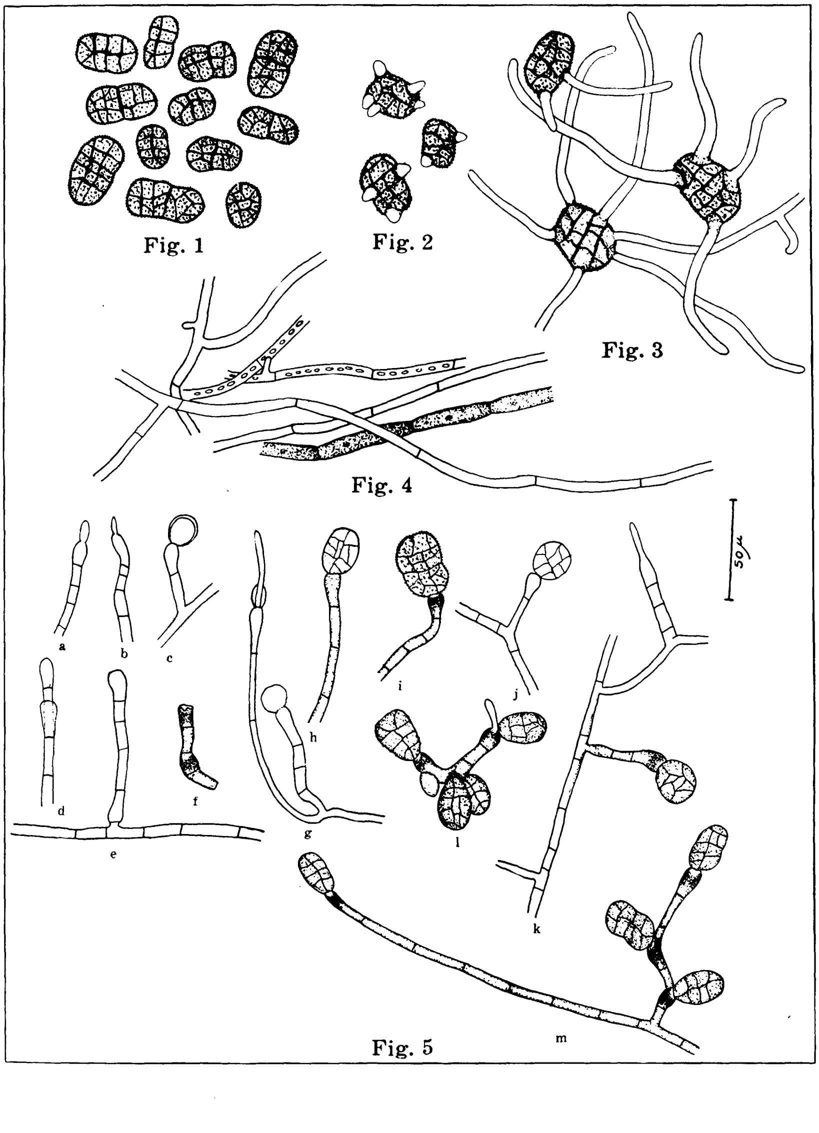


Fig. 1
Fig. 2
Fig. 3
Fig. 4
50 μ
a
b
c
d
e
f
g
h
i
j
k
l
m
Fig. 5

PLATE IX

FIG. 1. Photomicrograph from microtome sections of sterile perithecia which developed in pure culture on potato dextrose agar plate. Fixed, infiltrated with paraffin, and stained with Flemming's triple stain.

2. Photomicrograph from a section through an overwintered tissue of onion stem, showing the vertical section of a perithecium. Fixed in Gilson's fluid, infiltrated with paraffin, and stained with Flemming's triple stain.

3. Drawn with the aid of camera lucida. (*a*) a young ascus; (*b*) ascus with a slender paraphysis; (*c*) matured ascospores; and (*d*) and (*e*) two matured asci each containing eight ascospores.

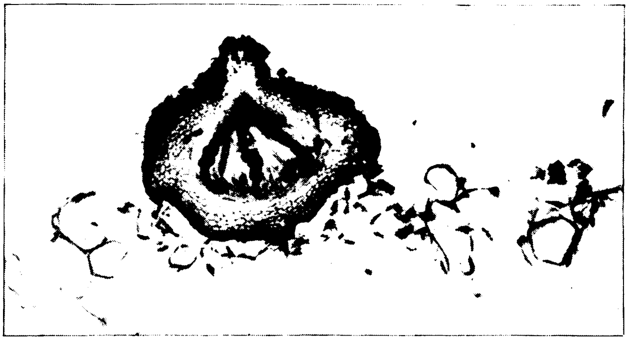


Fig. 2

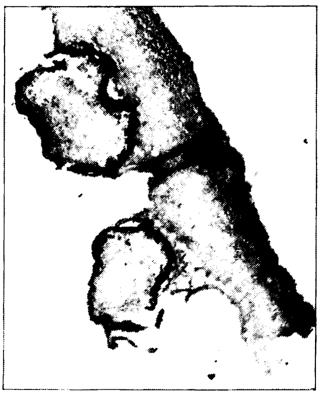


Fig. 1

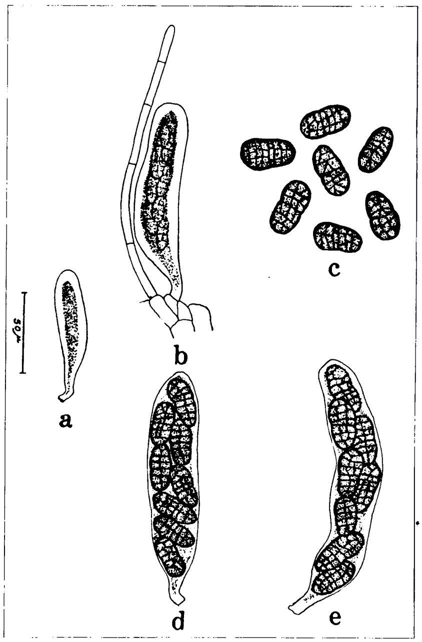


Fig. 3

Plate X

Petri dish and test tube cultures, grown from bits of mycelium. All 14 days old.

FIG. 1. Potato dextrose agar.

2. Potato dextrose agar with increased amount of sugar.

3. Peptone agar with little sugar.

4. String bean agar.

5. Potato dextrose agar.

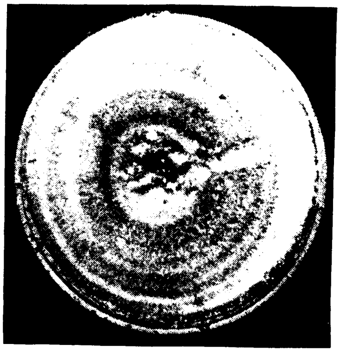


Fig. 1

Fig. 2

Fig. 3

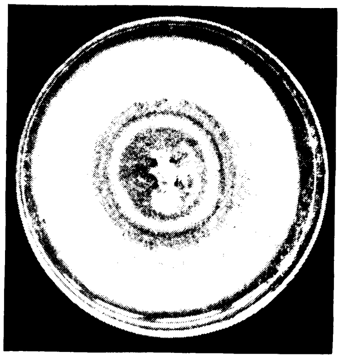


Fig. 4

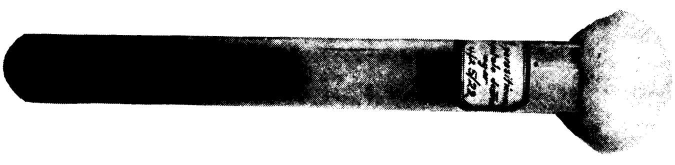
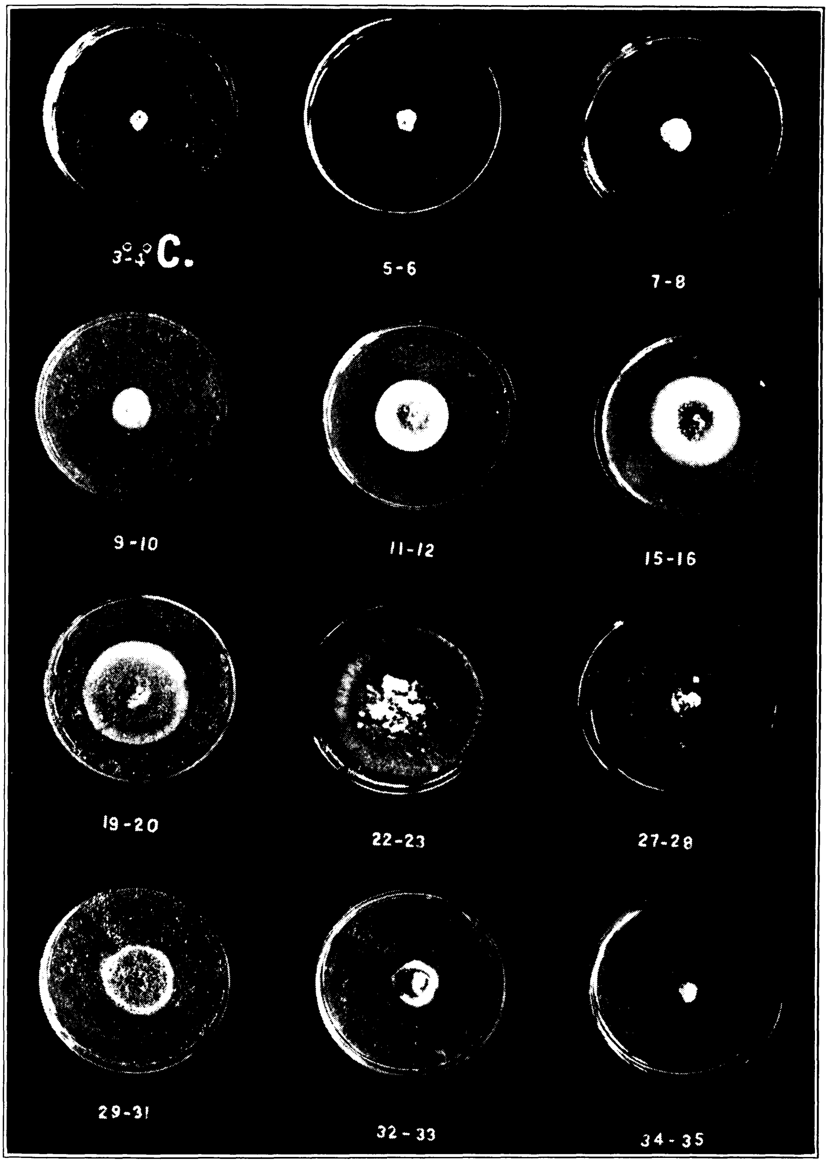
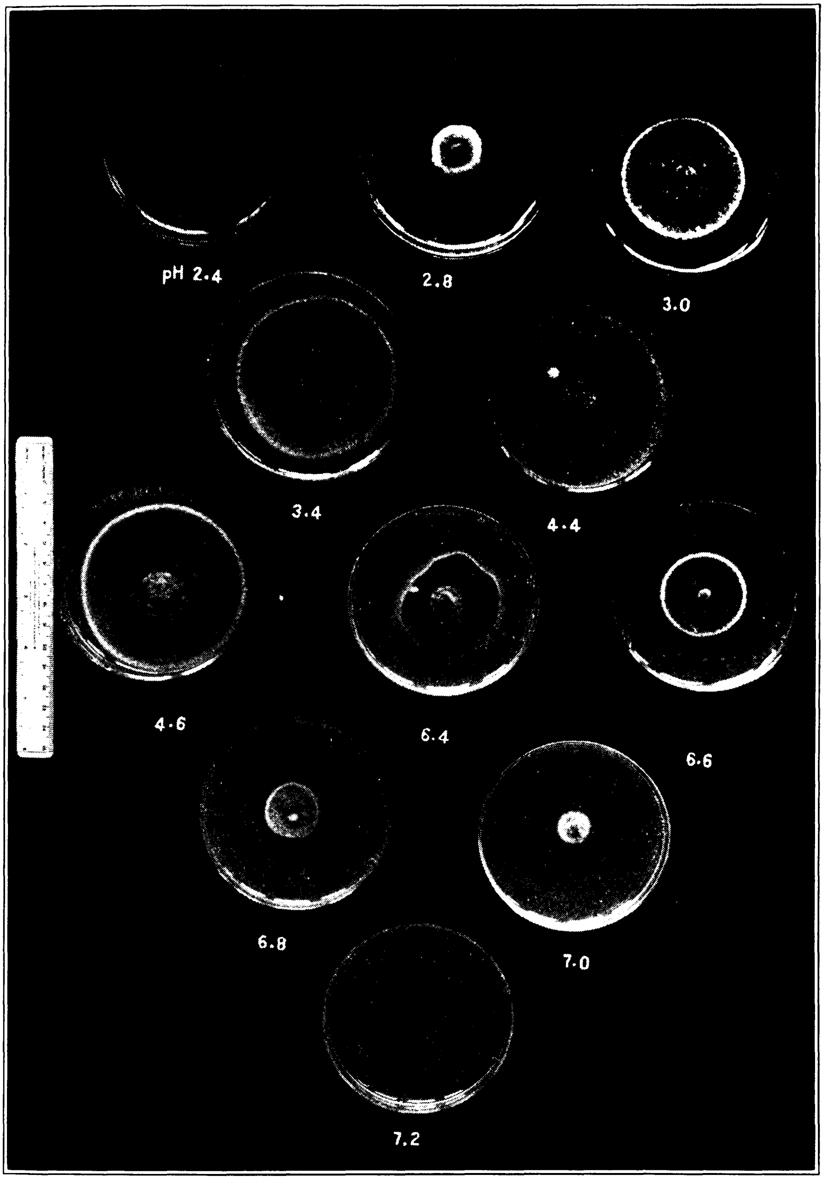


Fig. 5



All the plates were inoculated with bits of mycelium of nearly uniform size, and incubated for 10 days at temperatures ranging from 4° to 35° C.

Atanasoff's tube used to determine the moisture relation of the fungus.



A series of petri dishes containing equal amounts of potato dextrose agar previously adjusted to different hydrogen-ion concentrations, ranging from pH 2.4 to pH 7.2. Inoculated with bits of mycelium of approximately the same size as could be estimated. Kept at room temperature under a bell jar. Photographed after 10 days from the time of inoculation.

Photomicrograph from the wall of the petri dish culture. Note the grawth of the fungus from the cut edge of the agar.

Photomicrograph from a certain field of the preceding plate, highly magnified.

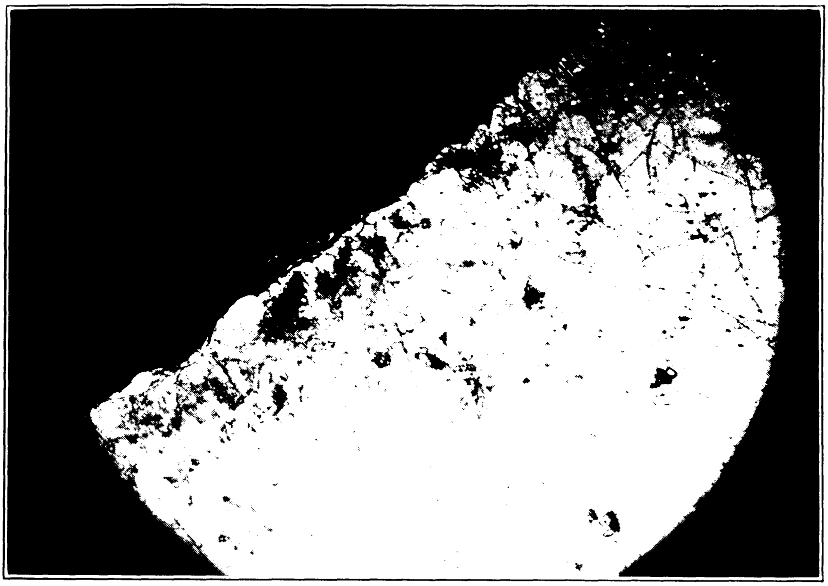


FIG. 1. Photomicrograph from the wall of the petri dish culture, showing the formation of perithecia. Note the growth from the cut edge of the agar.

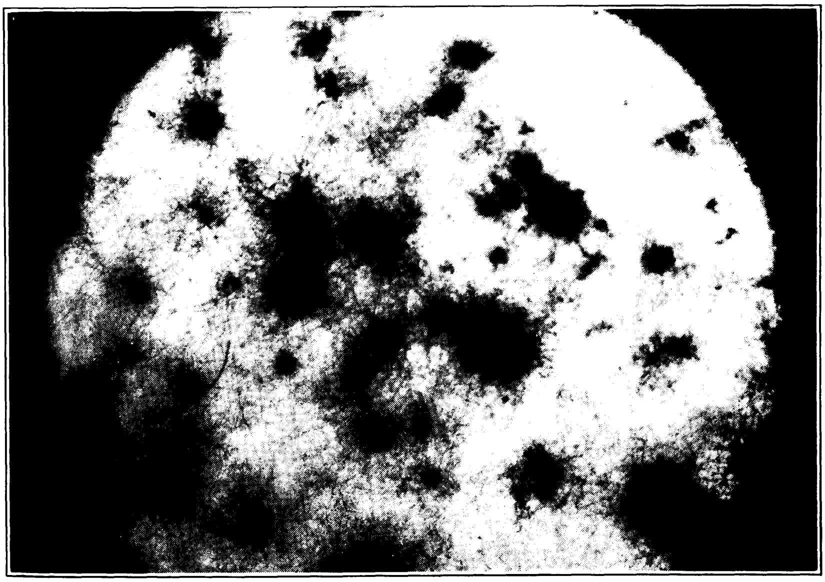
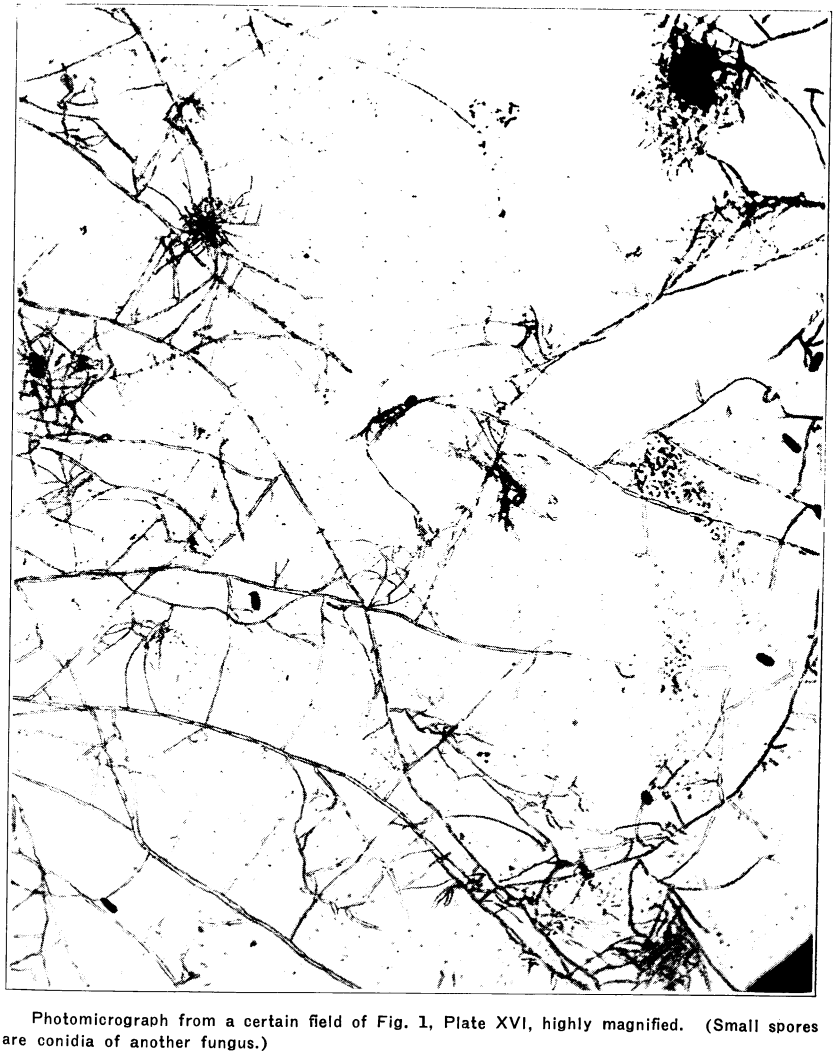
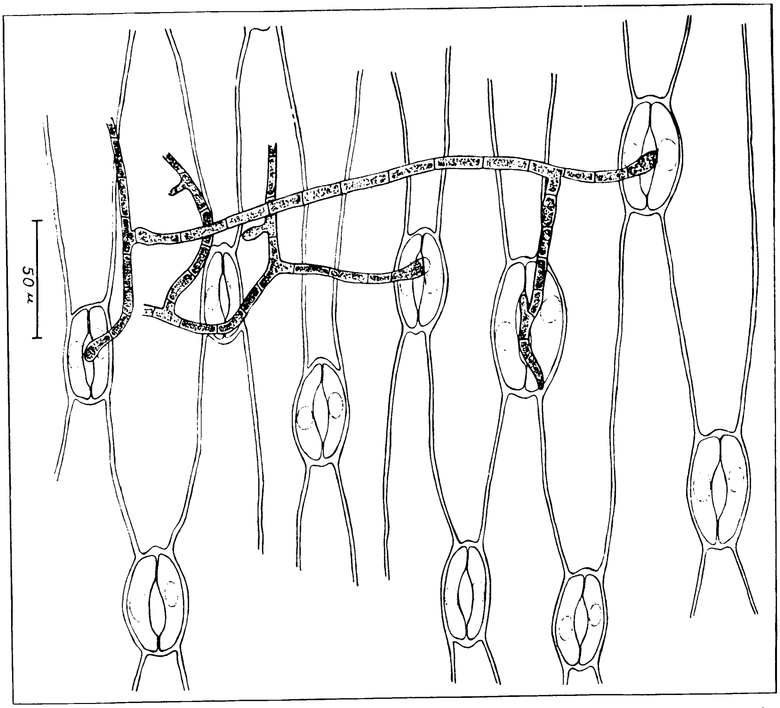


FIG. 2. Photomicrograph from a petri dish agar culture, showing perithecial bodies, later stage of the above.



Photomicrograph from a certain field of Fig. 1, Plate XVI, highly magnified. (Small spores are conidia of another fungus.)



Stomatal penetration of *M. parasiticum.* A thin portion of the epidermis removed from the surface of a white onion leaf directly beneath the infection drop. Fixed and stained with Pianese stain two days after inoculation. Drawn with the aid of camera lucida.

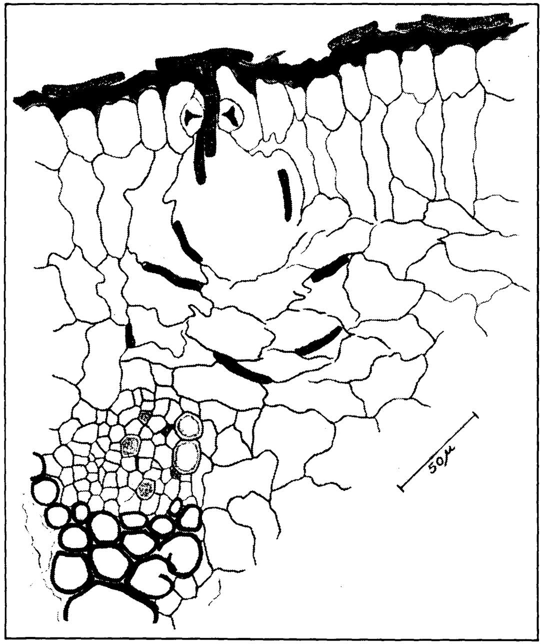
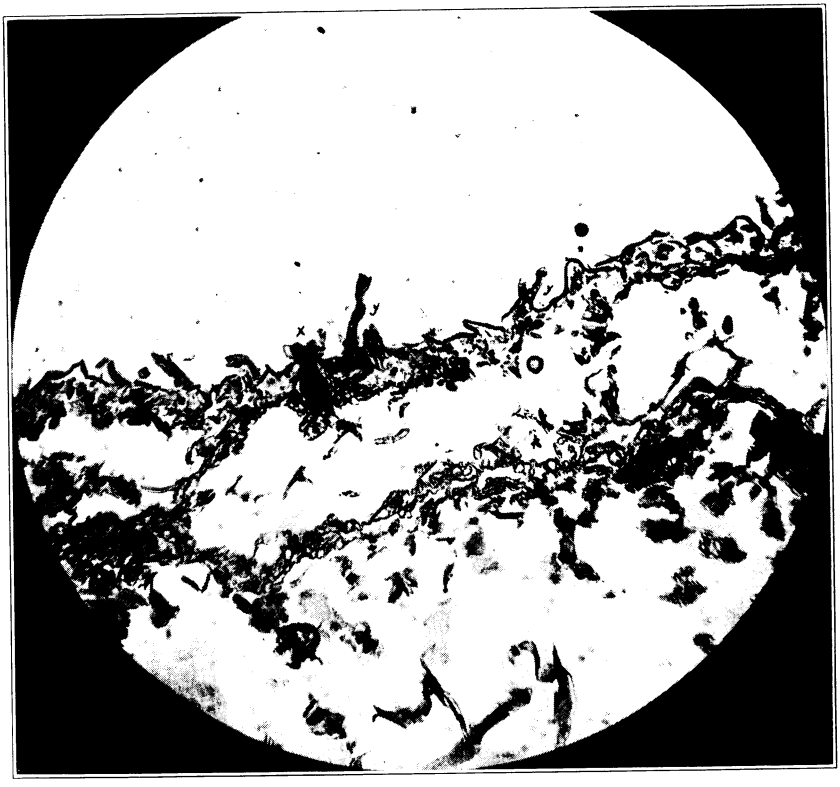


FIG. 1. Cross-section of a leaf of white onion inoculated with spore suspension. Note the germ tubes passing through the stomata, also the portions of mycelium between and within the cells. Preparation made five days after inoculation. Fixed in Gilson's fluid, infiltrated with paraffin, and stained with Flemming's triple stain. Drawn with the aid of camera lucida.

FIG. 2. Cross-section through an advanced lesion of naturally infected stem of "Egyptian onion." Note the mycelium beneath the cuticle and sending hyphal branches through the ruptured cuticle, and note also the penetration to the deepest layers of cells. Fixed, stained, and drawn as above.



Photomicrograph from a cross-section of a dry stem of "Egyptian onion" naturally infected with *M. parasiticum.* Note the advanced decomposition of the tissue of the host. Note the hyphae making their way to the surface, either through the stomata at (x) or directly through the cuticle at (y). Fixed and stained as in the preceding preparations.

SOAP AS AN EFFECTIVE CONTACT INSECTICIDE FOR THE PHILIPPINE MIGRATORY LOCUST

By Faustino Q. Otanes

With the exception of the ordinary methods, like driving the hoppers into pits and catching the fliers with nets, no other method of combating locusts has been used in the Philippines more than spraying with contact insecticides. In some places in the country crude oil and kerosene have been tried especially on hoppers. Pure crude oil and kerosene are undoubtedly effective, but the objection to their use is the expense. For this reason Jones and Mackie, formerly entomologists of the Bureau of Agriculture, recommended ordinary kerosene emulsion, with the statement that "even very dilute mixtures are effective against the very young hoppers." Tests made by the writer, however, with this emulsion, the dilusions used being 1 to 10 and 1 to 6 (the stock solution was made according to the formula: kerosene, 7.5 liters; soap, 400 grams; water, 4 liters), showed that it is not effective. Hoppers of the first stage or instar were sprayed with the solutions as liberally as possible to insure thorough wetting. While with the stronger solution, 1 to 6, about fifty per cent of the hoppers were drugged and apparently killed, yet most of them revived and were as voracious as ever. Only about 8 per cent of the hoppers died from the effects of the solution. Another solution, which is essentially kerosene emulsion, consisting of caustic soda, resin, kerosene, and water, and which is comparatively cheap has been found by Mr. Arsenio Goco, Supervising Locust Inspector of the Bureau of Agriculture, to be deadly to both hoppers and fliers, partly because of the resin, which is poisonous to insects. This solution has been used with considerable success in several places in the Philippines. One great trouble with this spray is that the resin and caustic soda are not available in most places in the Islands, and the expense and inconvenience of their transportation from a distributing center, like Manila, to where they are needed is an item which cannot be overlooked. The solution, however, should be used whenever the materials are available and wherever they can be easily transported.

Bearing in mind the enormous areas covered by locusts during an outbreak, simpler and less expensive sprays (everything considered, as availability ease of preparation and cost) are certainly to be desired. With this in mind the writer conducted tests with several substances at the Singalong Experiment Station in June, 1923, when there was again a bad locust outbreak as in the preceding year. Soap was one of the substances tested.

It is a matter of common knowledge, especially among entomologists, that soap is of value as an insecticide and is commonly used in other countries for soft-bodied insects, as plant lice or aphids, and is effective. Soap was among the first remedies employed against insects; it kills by contact, that is it clogs up the breathing pores or spiracles, thus suffocating the insects. While soap is commonly employed in other countries for soft-bodied insects like aphids, yet very seldom, if ever, has it been used alone for such a formidable pest as the locust. In the Philippines the writer is unaware that it was ever used to spray locusts before he tried it. That soap was never thought of as a locusticide may be because of its harmlessness on the human skin, unless of course when used excessively. And yet, in properly prepared solutions, it is so deadly, killing the locusts in a few minutes. The efficacy of soap as a contact insecticide for locusts as well as for other insects, lies in part in the fact that it has a very low surface tension and for this reason spreads very rapidly on the bodies of the insects and give them a complete wetting, penetrating most, if not all, of the breathing spores and clogging them up and perhaps irritating the tracheal or respiratory tubes.

LABORATORY AND FIELD TESTS

In the writer's test at the Singalong Experiment Station white, hard, Chinese laundry soap, ordinarily sold in blocks, was used. One block of this soap, weighing approximately 150 grams, was dissolved in five liters of water. It was sliced and the slices were wrapped in cheese cloth and the whole was rubbed and squeezed by hand until all the soap was dissolved. The soap may be also dissolved in boiling water. Hoppers of the third and fourth stages or instars, but mostly of the latter, were sprayed. The method of testing consisted in releasing a number of hoppers in the grass and then spraying them with a bucket pump provided with a disk nozzle, which delivered the soap solution upon the hoppers in a fine mist. It was found that the solution acted very quickly upon the hoppers as the insects began to succumb in less than a minute after spraying. Most

of them, however, succumbed six minutes after spraying, and the last hoppers after eight minutes. The hoppers were picked up as they succumbed and spread on paper and then placed in wire cages for observation. In one of these tests, in which 60 hoppers were used, 9 hoppers or 15 per cent of the entire number revived, but it was found that these remained sick and died afterwards, although they were supplied fresh grass every day.

It soon became urgent, owing to the bad locust outbreak during the year 1923 that extensive field tests should be made in order that, if found effective under field conditions, soap solution might be recommended to help remedy the situation. The presence of large number of hoppers in the vicinity of Manila furnished the opportunity for such extensive field tests without much trouble in transporting equipment and materials.

On July 3, 1923, the writer in company with Mr. Gonzalo Merino, Chief of the Plant Pests Control Division, Bureau of Agriculture and Colonel Aurelio Ramos of the Philippine Constabulary and a member of the Insular Locust Committee, went to San Pedro Macate, one of the towns near Manila infested by hoppers. The hoppers at San Pedro were in the fourth instar. Two blocks of hard, white, Chinese soap, each weighing approximately 150 grams, were dissolved in 10 liters of water at the rate of 0.6 kilo per 20 liters of water, or approximately one petroleum canful of water. The soap used in one petroleum canful of water cost 16 centavos, or 0.8 centavo per liter. A bucket pump with a disk type of nozzle was used in spraying. This solution was not effective in the field; very few hoppers were killed and some of these revived.

On July 5, the writer went to Fort McKinley again where hoppers were abundant, this time with Mr. Angel Arguelles and Mr. W. Schultze, chemist and entomologist of the Bureau of Science, respectively. Hard, white Chinese soap at the rate of 0.9 kilo per 20 liters at a cost of 24 centavos was used. This too was not found effective. Only a small number of the locust were killed.

The next day, July 6, the writer went out again to Fort McKinley in company with Colonel Ramos. At this time soap in the proportion of 1.2 kilos for 20 liters at a cost of 32 centavos, was tried. Pumps provided with rubber hoses about 10 meters long and with Vermorel nozzles were used. Better results were obtained with this solution, as was expected, as it was stronger. It was estimated that about 70 per cent of the locust sprayed, were killed.

On July 7, the writer went out again with Colonel Ramos to Fort McKinley. This time soft yellow Chinese soap was used at the rate of 0.3 kilo in 10 liters at a cost of 0.9 centavo per liter. The test was made right on the grass in the open so that the effect of the spray could be easily observed. All of the hoppers that were wet with the solution began to succumb in about 1 minute and all succumbed in less than 4 minutes. Thus this solution was found more effective than the white soap at the rate of 1.2 kilos per 20 liters and yet cheaper than the latter.

Further tests made near Fort McKinley on July 9, 1923, by the Director of Agriculture, the Chief of the Plant Pests Control Division, and the writer, confirmed the results obtained on July 7, so that there remained no doubt as to the effectiveness of the yellow soap as a locusticide. Accordingly it was decided to use it as a spray at Fort McKinley, which was then heavily infested by hoppers. Yellow soap at the rate of 0.5 kilo per 20 liters of water was used and the spray was applied with bucket pumps, each with a rubber hose about 10 meters long and a Bordeaux nozzle. This nozzle was found excellent because it gives a fan-shape spray and consequently more hoppers can be sprayed. Hundreds of soldiers were then being used in combating the locusts by the ordinary driving and pit methods. The solution was found especially valuable in killing the hoppers congregated in the bushes and shrubs, which made it difficult for the men to drive the hoppers. The officers and soldiers who saw the spraying expressed satisfaction at the effectiveness of the soap. Later Ex-Governor Eulogio Rodriguez of Rizal, then Mayor of the City of Manila, who himself was in the field directing the campaign throughout in coöperation with the military had soap purchased and ordered his inspectors to use it at Fort McKinley and in other places in Rizal Province infested by locusts.

On July 11, by order of the Director of Agriculture, telegrams were sent to all locust inspectors of the Bureau of Agriculture instructing them to use soap as a spray at the rate of from 0.4 kilo to 1 kilo to about 20 liters of water. Later, on July 16, the writer prepared the following circular, copies of which were sent to all inspectors and other people engaged in the fight against the locusts:

BUREAU OF AGRICULTURE CIRCULAR NO. 138

Ordinary laundry soap dissolved in water has been found by this office to be deadly contact poison to locusts; it clogs up the breathing pores or spiracles and thus kills them in a few minutes. Inspectors of

the Bureau of Agriculture are therefore advised to use it and recommend it to all engaged in locust control work.

KIND AND AMOUNT OF SOAP TO USE

The soft yellow or wax-colored Chinese laundry soap should be dissolved in one petroleum canful water (approximately 20 liters). Put the soap cut into small bits into a cloth bag strong enough to stand pressure—coarse abaca cloth has been found good—and squeeze or rub it until dissolved.[1]

HOW AND WHEN TO SPRAY

Much of the success with any spray solution depends on the appliances used and the thoroughness of and the time of application. In spraying locusts, a bucket pump is good, with about 10 meters of rubber hose and a nozzle which will deliver the liquid upon the hoppers in a fine mist. The Bordeaux type of nozzle is excellent, but other types of nozzles, such as the Vermorel, will do.

Care should be taken that the hoppers are thoroughly wet with the solution, as it should be kept in mind that the insect has eighteen breathing pores or spiracles, nine on each side of the body, and the soap solution must enter all the pores, and penetrate the breathing tubes or tracheae and clog them up completely so the hoppers will die from suffocation. The best time to spray is in the evening and early in the morning when the hoppers are all together. For spraying flyers see directions given in the Circular relative to the Resin-Kerosene Emulsion.

ADVANTAGES OF SOAP AS A LOCUSTICIDE

Soap as a locusticide has several advantages, among which are as follows:

(1) It is cheap. One-half kilo of soft Chinese soap dissolved in 20 liters of water has been found sufficient to kill hoppers of the fifth stage or instar and all other active stages at a cost of only 16 centavos per 20 liters and this can be reduced if the soap is bought wholesale.

(2) Soap is sold everywhere.

(3) The solution is easy to prepare.

(4) Unlike certain other insecticides recommended for locusts it is not poisonous to man, domestic animals and birds.

Field inspectors who used the soap soon reported to the Bureau encouraging results of their spraying. Mr. Alex A. Beacon locust inspector stationed in Negros, wrote: "The solution (soap solution) as per telegram received from the Director of Agriculture, was tried on the Hacienda Concepcion, of the Municipality of Murcia, and it was found to kill the hoppers of the first and second stages almost instantly. Mr. and Mrs. Valeriano Gatusla, and many of the workers witnessed the use of the said solution on the hacienda on July 13, 1923. Another inspector, D. M. Pascual, in Rizal, wrote as follows: "We are glad to report the tremendous success we obtained with the soap solution in killing hoppers." Other inspectors in Bulacan reported that

[1] If firewood can be easily obtained in the field the soap may be dissolved in hot water.

the soap solution was found effective on fliers as well as on hoppers, thus confirming the results obtained in the laboratory.

Mr. Antonio C. Torres, Locust Inspector for Tayabas and Laguna, also reported that soap was used under his direction in those provinces during August and September, 1923, and the people who saw the results of the spraying were very much impressed with the effectiveness of the soap.

The statement has come from various sources that hoppers sprayed with soap solution revive sooner or later after the soap has dried off. This all depends upon the kind of soap and the concentration of the solution. As our tests have shown the hard white soap, while found effective in the laboratory, was not found so in the field except in concentrated amounts, in which case the cost of spraying would be high. The soft soaps in general, such as the yellow Chinese soap are more effective in comparatively less amounts and thus cheaper. The right concentration of the solution, as is true with other insecticides, however effective they are, must always be borne in mind if the best results are to be obtained. The writer has found that dilute solutions of the yellow Chinese soap are not effective. This is why less than 0.4 kilo of soap in 20 liters of water is not recommended even for the youngest hoppers.

Success with the soap also depends, as has been said elsewhere, upon the spray pumps used. Nozzles which give a fine mist are to be preferred, for the waste is reduced to the minimum, more hoppers can be sprayed and the insects get a more thorough wetting.

SUMMARY

Ordinary laundry soap has been found an effective contact insecticide for the Philippine migratory locust, killing the insect in a few minutes. Soft soaps, as the ordinary yellow Chinese soap, are more effective than the hard soaps. A half kilo of soft Chinese soap dissolved in 20 liters of water has been found sufficient to kill fliers as well as hoppers of all stages.

Soap solutions have a very low surface tension and consequently spread very rapidly. This accounts partly for their effectiveness as sprays for locusts as well as for other insects.

RECOMMENDATION

For spraying, the soap solution is so far the most effective and cheapest remedy found for locust control. Each municipality should equip itself with a number of bucket spray pumps with 10 meters or longer rubber hoses and Bordeaux and Vermorel nozzles.

CHARACTER AND USEFULNESS OF FIBERS FROM PETIOLES OF BURI PALM WITH MEASUREMENTS OF THE TENSILE STRENGTH OF THE FIBERS

By R. B. ESPINO, *Consulting Fiber Technologist* AND G. C. ZABELLA [a]

I. INTRODUCTION

The most valuable material derived from the buri palm (*Corypha elata* Roxb) is buntal fibers, which are extracted from the petioles of the palm and extensively used for making fine hats. The famous Lucban hats and buntal Baliwag hats are made out of these fibers, and constitute an important industry of this country. Statistical data on exports show that the industry is growing from year to year. In 1914, for example, the number of hats exported was only 198,641 valued at ₱525,000. Five years later each of these figures was more than doubled. In 1919 the number of hats exported was 350,721 bringing back to these Islands the rather large sum of ₱1,149,698.[b] Should the number and the value of the article sold in the country be added to these figures, the value of the industry would approximate about two million pesos for 1919.

The present study was carried out to determine the comparative qualities of fibers obtained from the different petioles of the palm, with the object of being able to know which petiole or petioles bear the best kind of fiber. This information, it was believed might lead to the determination (*a*) of the proper number of petioles ready for harvest, and (*b*) best classification of the fibers according to their qualities, which would help to establish the price of the fibers and of the hats made from them, according to quality.

The microscopic part of this study as well as the test on the tensile strength of fibers was carried out at the College of Agriculture. Other information and the materials employed were collected in Tayabas, Tayabas. This study covered a period of nearly one college year and ended about the middle of March 1921.

---

[a] Thesis presented for graduation from the College of Agriculture in 1921. Experiment Station contribution No. 215.

[b] Data obtained from the office of the Bureau of Customs.

II. MATERIALS, METHOD, AND RESULTS

1. MICROSCOPICAL STUDY OF FIBER

A petiole from a full grown plant was cut transversally at a distance of two and one-half meters from the base of the leaf and its cross-section (see Plate XXI, fig. 1), showing the distribution of vascular bundles and fiber strands, was drawn using a hand lens as a magnifier. The fibers in a petiole were grouped into four classes, according to location in the petiole,—as A, B, C, and D. Microscopical study of the fibers in these portions was made. Razor sections mounted on slides were prepared from the different portions. Every section was examined under the microscope using a low power objective, and noting the characteristic and relative sizes of vascular bundles and fiber strands. Typical and representative vascular bundles and fiber strands found in each portion were drawn (see Plate XXII, figs. 1–5 from portion A, Plate XXIII, figs. 1–4 from portion B, Plate XXIV, figs. 1–5 from portion C, and Plate XXV, figs. 1–5 from portion D). A camera lucida was used in making these drawings. Sections were also prepared from fibers in the market and the drawings are shown in Plate XXVI, figures 1–3.

Small samples of fibers obtained from the different parts (indicated as A, B, C, and D, in Plate XXI, fig. 1) were macerated. The method of maceration here employed was similar to that followed by Espino (1) and Mendiola (2), more particularly of the latter; the nitric acid used was diluted with a little water.

The macerated fiber elements were carefully examined and representatives samples drawn. These drawings are shown in Plate XXI, figures 2–5. Careful measurements of the length, gross diameter, thickness of wall and diameter of the lumen were made with the use of a microscope, stage and eye piece micrometers. The average results of these measurements are presented in Table I.

2. TESTS ON TENSILE STRENGTH OF FIBER

In the study of tensile strength of buntal fibers two series of tests were made. Series I was the study of the stretching ability and relative strength of fibers extracted from different petioles of a plant. Series II was a comparative study of the stretching power and strength of fibers obtained from different portions of a petiole. Single fiber tests were made. The fiber samples were 75 centimeters in length and were taken at random

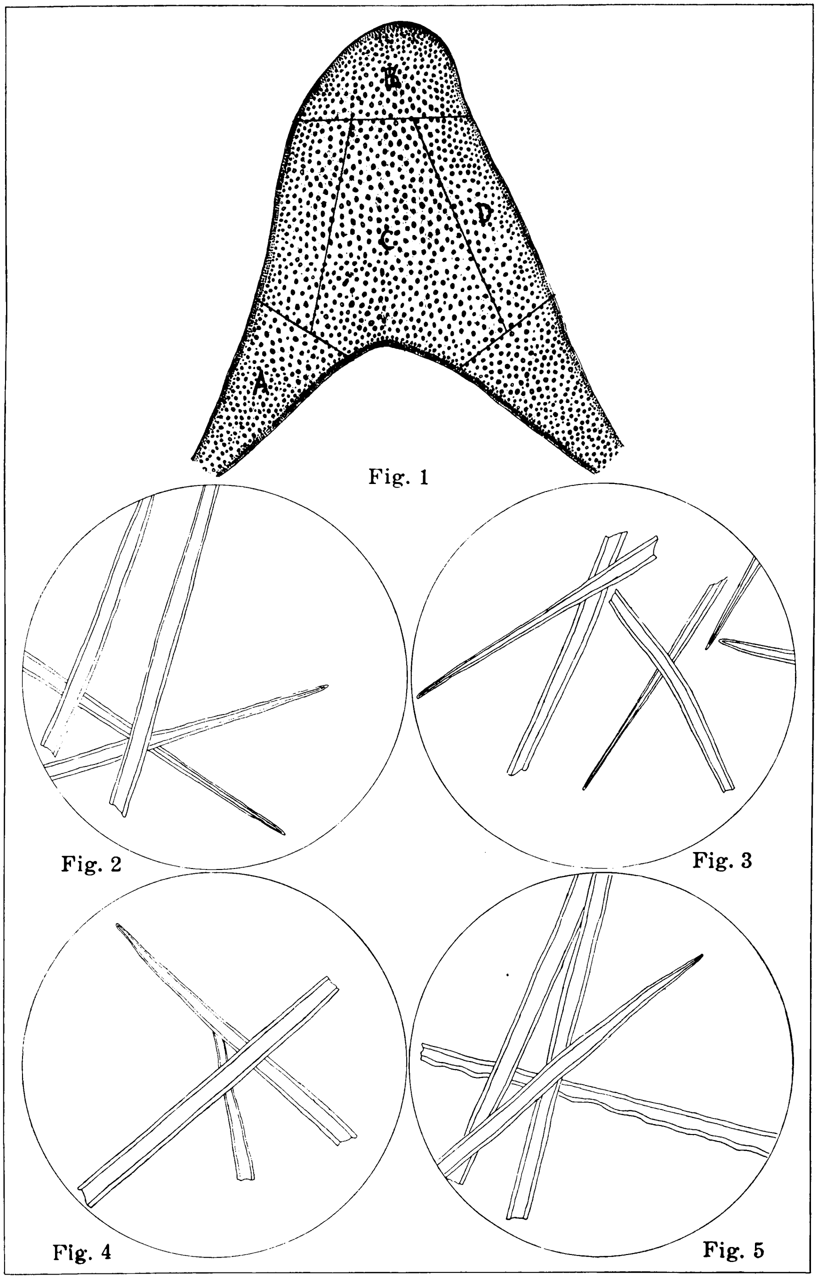
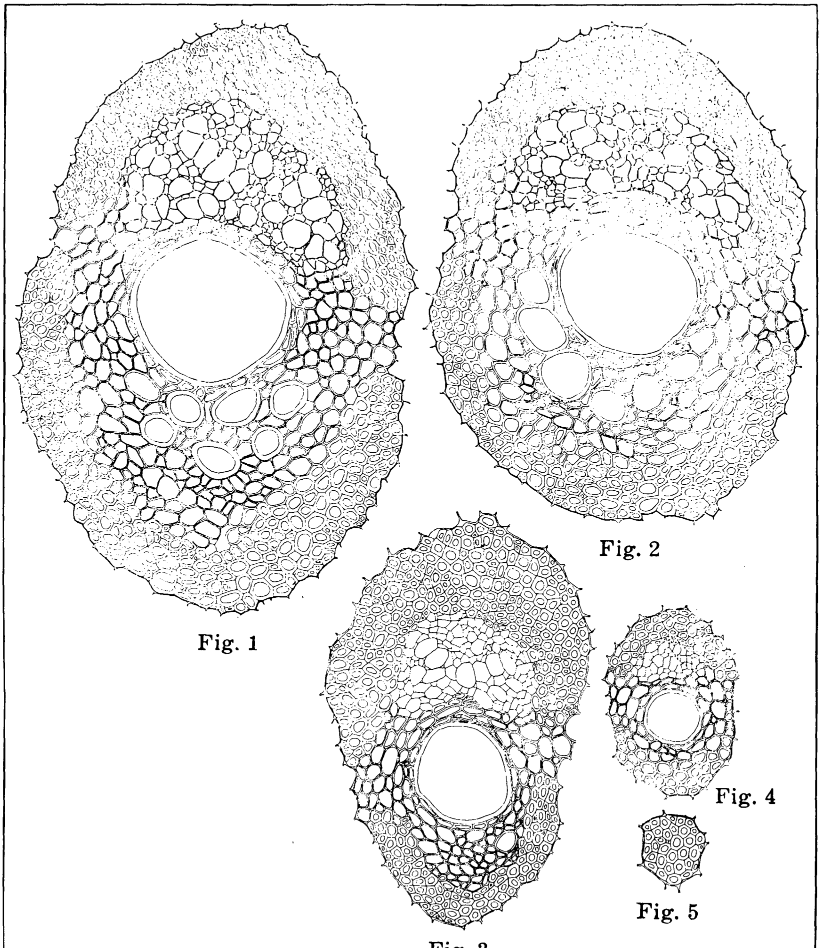
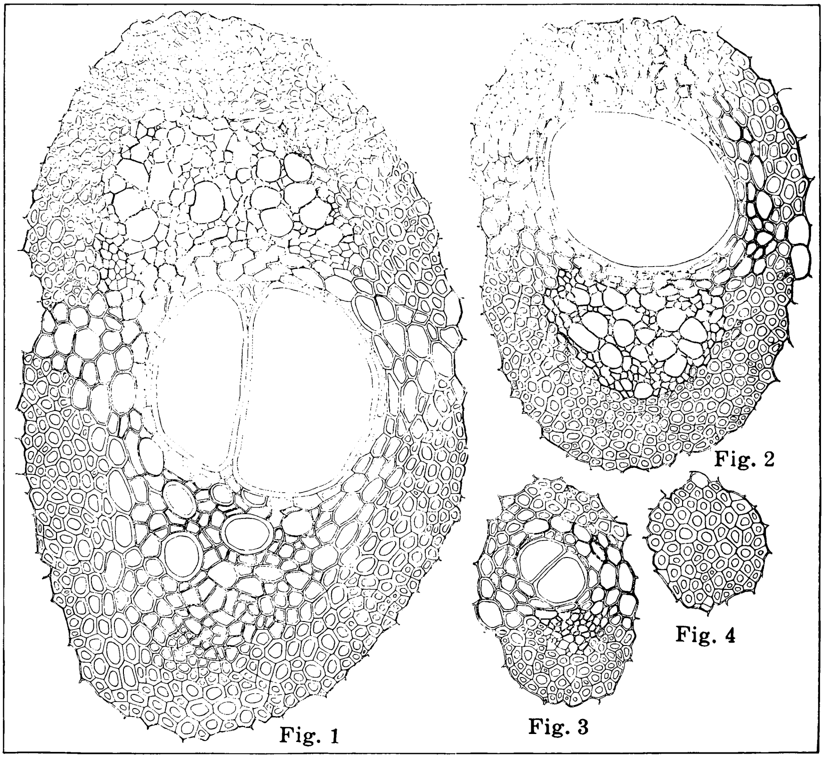


FIG. 1. Transversal section of a petiole 2½ meters from the base of the leaf showing the distribution of fibers, and showing portions A, B, C, and D.

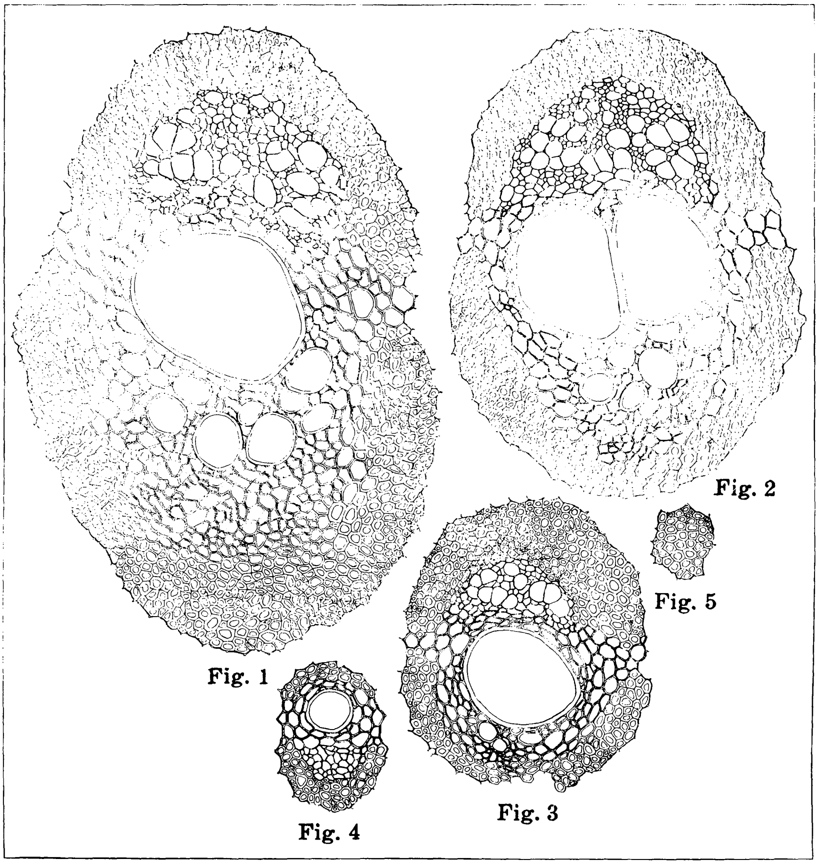
FIGS. 2–5, inclusive. Fiber cells (lengthwise) from A, B, C, and D, respectively.



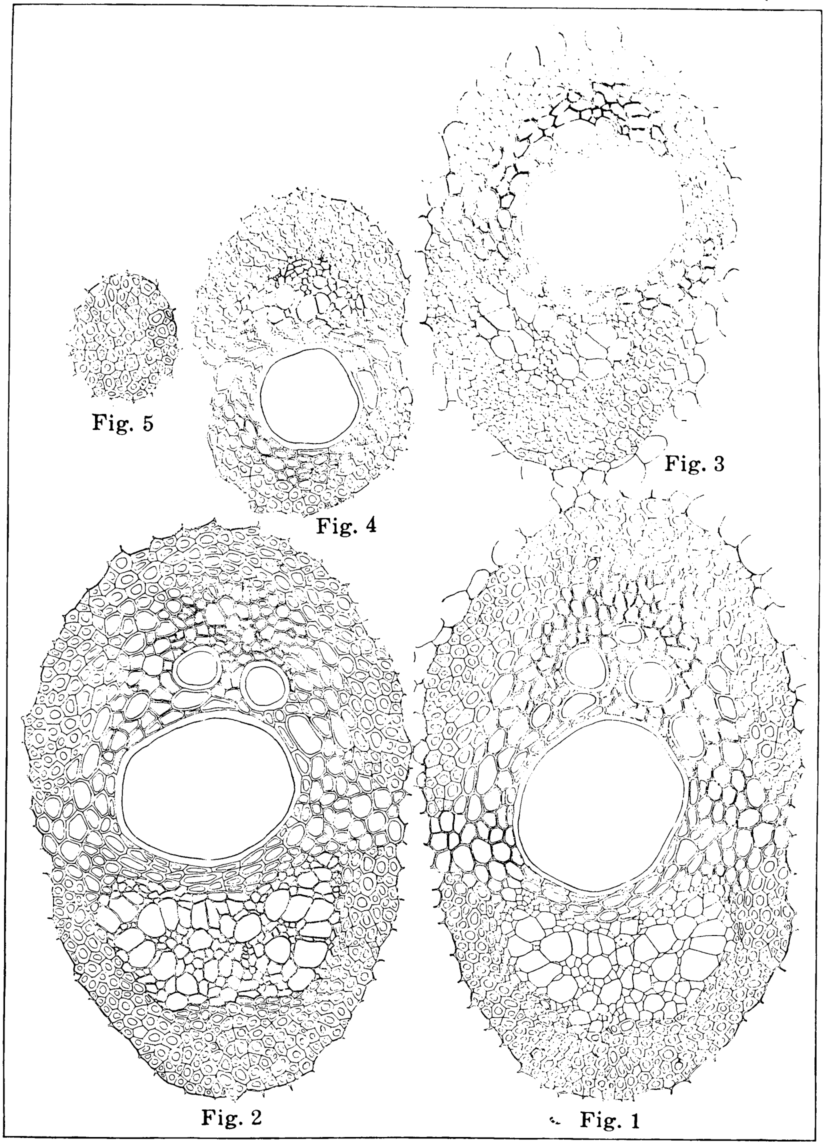
FIGS. 1-4, inclusive. Cross sections of vascular bundles from portion A.
FIG. 5. Cross section of a sclerenchyma strand from portion A.



FIGS. 1–3, inclusive. Cross sections of vascular bundles from portion B.
FIG. 4. Cross section of sclerenchyma strands from portion B.



FIGS. 1–4, inclusive. Cross sections of vascular bundles from portion C.
FIG. 5. Cross section of sclerenchyma strand from portion C.



FIGS. 1-4, inclusive. Cross section of vascular bundles from portion D.

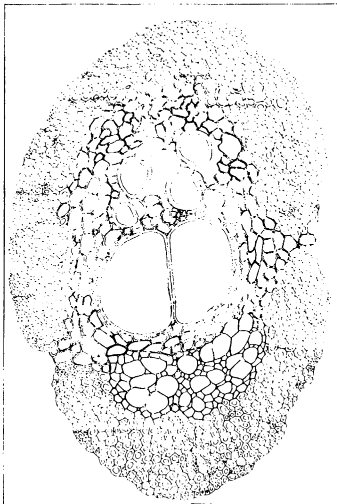


Fig. 1

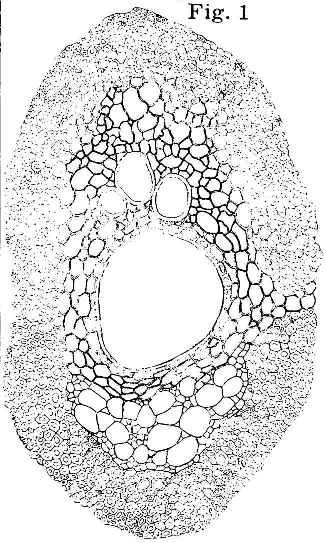


Fig. 2

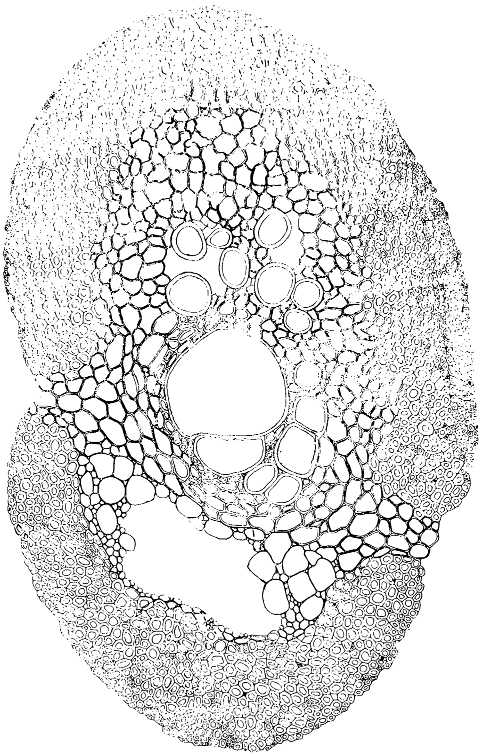


Fig. 3

FIGS. 1–3, inclusive. Cross sections of the fibers from the market.

from the bunch of fibers from the different petioles, in the case of Series I. For Series II, the samples of fibers were likewise taken at random. Ten tests were made for each case; while making the tests precaution was taken that no current of air interfered with the experiment. Care was taken to discard all trials made in which the break occurred at the point of attachment. The data obtained from these tests are summarized in Tables II and III.

These tables show not only the data on the tensile strength of the fibers but also on their ability to stretch. Data in Table II are plotted in fig. 1.

TABLE I.—*Average dimensions of fiber cells from different portions of a petiole.* (*All readings in millimeters*)

	From portion of petiole			
	A [1]	B [2]	C [3]	D [4]
Length of cells	2.0484	2.1051	2.1735	2.0383
Gross diameter of cells	0.0176	0.0179	0.0182	0.0170
Thickness of wall	0.0025	0.0030	0.0028	0.0026
Diameter of lumen	0.0125	0.0112	0.0149	0.0122

[1] At the edges.
[2] On back or midrib.
[3] Central part.
[4] Along the side; near the outer epidermis.

TABLE II.—*Summary of stretching and strength of fibers*

Petiole	Stretching	Breaking weights	Weight of sample	Strength calculated to 1 gm. basis
	cm.	*gm.*	*gm.*	*Kg.*
1	6.26	2896.59	0.1289	22.4594
2	5.71	2826.65	0.1184	24.0888
3	4.46	3535.87	0.1484	23.8470
4	6.14	3275.79	0.1289	25.3444
5	5.68	3511.31	0.1444	24.3083
6	5.16	3001.41	0.1291	23.1256
7	4.61	2735.13	0.1207	23.0748
8	3.16	3037.34	0.1337	22.8112
9	3.76	3529.11	0.1546	22.8248
10	3.66	2713.95	0.1246	22.1797

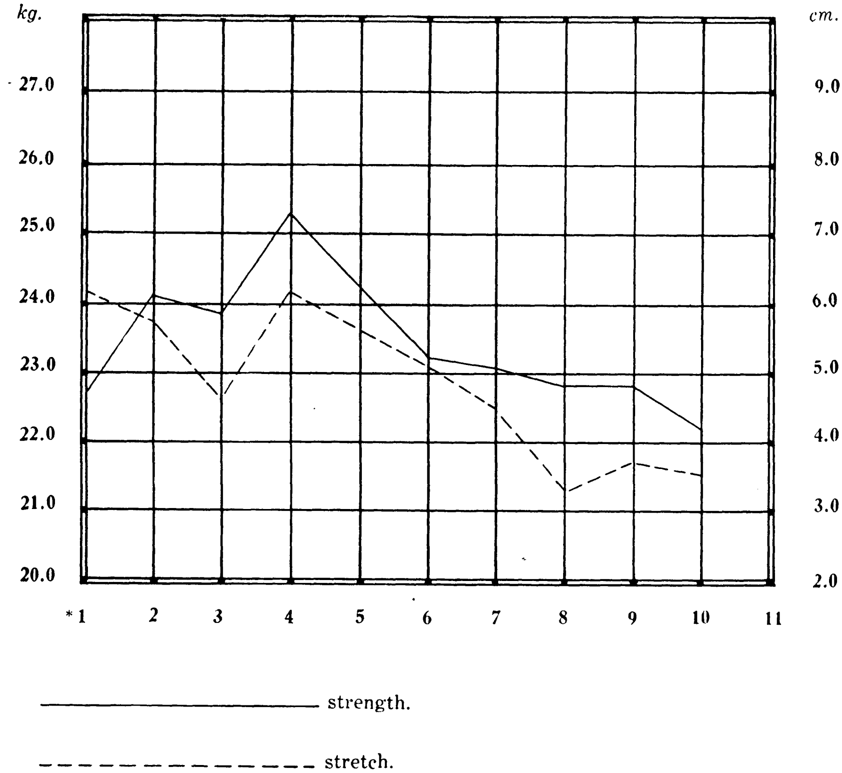
TABLE III.—*Summary of data on stretching and strength of fibers*

Portion	Stretching	Breaking weights	Weight of sample	Strength calculated to 1 gm. basis
	cm.	*gm.*	*gm.*	*Kg.*
A	6.38	2713.08	0.1069	25.5456
B	5.01	4195.05	0.1665	25.3522
C	6.99	2910.10	0.1172	24.7057
D	7.83	4641.95	0.1479	31.3919

The apparatus used for these tests was similar in principle to the one used in 1915 by Espino in his study of abaca fiber. This apparatus was constructed with a horizontal wooden bar sup-

ported by two firm posts set on two stands. At the middle of the wooden bar an iron clamp was fixed to hold the upper end of the fiber. Another clamp, on one end of which a small piece of

FIG. 1.—*Tensile strength of fibers from the different petioles. (Data from Table II)*



* Outermost petiole.

celluloid scale graduated to millimeters and to which a weight was attached, held the lower end. The scale was used to measure the stretching of the fiber. A small tin can was attached to the lower clamp in which additional weight (small shots) was placed.

3. AMOUNT OF FIBER IN DIFFERENT PETIOLES

The amount of fibers from each petiole was also ascertained. For this purpose three palms were the subject of the study. A rather heavy harvest was made of the leaves of these palms. Seven leaves were harvested from each of two of the trees and eight leaves from the third tree. The fibers from each of the

petioles of these leaves were extracted, dried in the shade, then counted and their weight determined. The numerical data obtained are presented in Table IV.

TABLE IV.—*Yield of fiber (of standard length)*[a] *of different petioles of full-grown plants*

Petiole number	Plant I		Plant II		Plant III	
	Number of fiber	Weight of fiber	Number of fiber	Weight of fiber	Number of fiber	Weight of fiber
		gm.		*gm.*		*gm.*
1	[b] 416	[b] 69.2	[b] 500	[b] 95.0	[b] 156	380
2	[b] 552	[b] 82.6	257	57.5	226	46.9
3	[c] 50	[c] 10.1	289	61.5	152	36.1
4	[c] 153	[c] 22.1	210	54.4	184	44.8
5	221	33.7	170	34.5	273	54.1
6	256	34.6	224	44.3	193	31.7
7	261	33.1	290	54.1	194	35.0
8					136	25.4
Total	1,909	285.4	1,940	401.3	1,504	312.0

[a] About 1.3 meters in length.

[b] The figures are based on the number and the weight of fibers obtained from a petiole after being cut in two pieces, according to standard length of fibers.

[c] The low yield was due to cutting of the blade of the leaf while the latter was yet young.

III. DISCUSSION OF RESULTS

1. GENERAL OBSERVATIONS

From the personal experience of the junior author (being a resident of buntal fiber producing town, Tayabas, Tayabas), and from the observation of those with experience in the extraction of fibers, as well as from what was observed during the progress of the study, it appears that certain buri palms produce mostly fine fibers, while others, however, produce relatively coarse fibers. These facts seem to indicate either that there are probably distinct varieties or individual variation of this palm as regards quality of fiber yield; or that the size of fibers produced in each palm depends upon the age of the tree as well as upon the soil and climatic conditions which may influence the development of the fiber.

The fibers in different petioles on a tree, as a general rule, are quite uniform in size, although the fibers from the outer or older petioles are slightly coarser than those from the inner or younger petioles. In color, the fibers from the different petioles vary a little from the pale yellow of the fibers from the outer petioles to the white of those in the inner petioles of the same plant.

With regard to the size of fibers from the same petiole, it appears that the central portion is always filled with relatively coarser fibers than those obtained from other parts of the petiole.

It appears, further, that unlike the fibers in the leaf sheath of abaca, the buntal fibers are mostly vascular bundles. Small sclerenchyma strands are, however, also found but those along the side of the petiole are cut off before extracting the fiber. Also, during extraction the small sclerenchyma strands found in the central portion of the petiole are often broken and discarded. However, those that are extracted in perfect condition may be employed in the manufacture of fine-woven hats.

2. MICROSCOPICAL STUDY OF FIBERS

(*a*) *Fibers in the petiole.*—Microscopical study of fibers in the petiole of buri palm, Plate XXI, figure 2, has revealed the fact that most of the sclerenchymatous structures at the central portion of the petiole are vascular bundles. There are, however, mixed with these, pure sclerenchyma strands. In cross section, the vascular bundles are oval in shape and are composed largely of xylem portion and phloem portion which are enclosed by sclerenchymatous cells, or the bundle sheath. (See Plates XXIII to XXVI.)

Besides the vascular bundles, pure sclerenchyma strands are also found in the petiole. These structures are composed of from about 23 fiber-cells in the smallest strand to as many as 61 fiber elements for the largest fiber (see fig. 5 in all the Plates except Plate XXI).

Careful measurements of some of the fiber structures have shown that some of the largest extractable vascular bundles (Plate XXVI, fig. 3) were 1.110 millimeters in maximum gross diameter. The smallest was 0.672 millimeters. Other vascular bundles found in the petiole, as well as those already extracted, gave the characteristic dimension of about 0.59 and 0.44 millimeter for the two gross diameters (Plate XXII, figs. 2 and 3). These fibers, large as they appear when measured in cross sectional area, have really relatively few fiber elements. The big bulk of the structures is composed of xylem cells and phloem cells. Probably more than one-half of the entire cross sectional area of these fibers is filled up of elements which are not fitted to give tensile strength. In fact the main bulk of the central portion of the fiber is empty space, either lumina of small paranchymatous cells, or cells of phloem or lumina of relatively large vessels. In a cross section of the fiber found in the market or at the two cut ends of the fiber, large holes at the center are easily seen even with the naked eye. These holes are either the lumina of large vessels or broken spaces due to the destruction of some of the rather tender phloem elements.

The sclerenchyma strands are more nearly rounded in their cross sectional area than the cross sectional area of the vascular bundles. They measure about 0.08 millimeter in diameter for the smallest structure and about 0.13 millimeter for the largest. The presence of only sclerenchymatous elements or the absence of big vessels and other conducting tissues make them stronger than the vascular bundles of about equal diameters. These materials would prove valuable in the manufacture of very fine hats, were they to be obtained easily and in large quantities to supply the demand of the discriminating markets. Unfortunately, however, the supply is always far below the demand. Effort should be exerted in searching fur buri palms the petioles of which are rich in this structure.

From the results of the microscopical study made by Espino (1915) with abaca fibers in the leaf sheath, and from the results of the microscopical part of this study, it would seem that in the case of abaca, strong fibers in the market are usually made of pure sclerenchyma strands found along the outer epidermis of the leaf sheath. The buntal fibers in the market are usually obtained from about the central portion of the petiole. In case of abaca the vascular bundles found near or at the center of the sheath are so weak that they are discarded even during taxying,[3] a process performed prior to the extraction of the fiber.

Espino found that the relatively strong and fine fibers of abaca are located at the two edges of the sheath. In the present study fibers obtained from portions A, B, C, and D, in Plate XXI, figure 2, seem to be fairly uniform in size. As already mentioned, some of the fibers, however, in portion C are somewhat larger or coarser than the largest fibers in the other portions.

(*b*) *Fiber from the market.*—A sample of buntal fiber was secured from a hat manufacturer in Tayabas. This fiber was brought to the laboratory and upon microscopical examination of the cross section of several fibers it was found that they were all vascular bundles, Plate XXVI, figures 1–3. From the appearance of these fibers and of the vascular bundles (Plate XXII to XXV) drawn from fibers obtained from the different portions of the petiole, it is fairly safe to say that they are identical in appearance and in structure or composition. The fibers, therefore, of this palm found in the market are extracted from the four portions of the petiole indicated A, B, C, and D in Plate XXI, figure 1. Moreover, unlike stripped abaca

[3] Taxying is separation of fibrous layer from its pulp. Taxy applies to the process in which fibrous layer of the abaca sheaths is removed from the pulpy portion.

fiber, the buntal fibers appear almost the same as when in the petiole, while those of abaca are a little flattened or broken into pieces and the conducting tissues smashed. This difference is due to the methods of extraction employed. In the case of abaca, as is well known, the fibers are pulled between the blade of a bolo or knife and a wooden block. The buntal fiber, however, is pulled out with the hand, one by one or several fibers at a time, from the petiole. The fibers of buntal therefore, remain unflattened and almost of the natural shape in the petiole. However, due to drying and shrinking of the cells, especially those of the xylem and phloem portions certain broken cells somewhere in the central portion of the dry fiber are occassionally found, see Plate XXVI, figure 1.

(*c*) *Fiber elements.*—The fiber elements are long and narrow attenuated at the two ends. They look like the fiber elements of abaca. The fiber cells of buntal appear to have clean lumen and have uniformly thickened walls. They do not have any septae, or cross walls or any marking on the walls. They are decidedly shorter than those from any portions of the leaf sheath of abaca. In abaca, the average length of the fiber elements for rope making as reported by Espino was about 5 millimeters, and in two cases he found that the fiber cells attained a length of 8.96 millimeters, and 8.45 millimeters. As shown in Table I, the length of the fiber elements of buntal did not exceed 2.5 millimeters. If the common belief that fibers made up of short cells, other condition being similar, are weak, the buntal fibers are probably relatively weak as compared with the abaca fiber. Espino found in the case of abaca that the fibers with shorter elements are stronger than those that are made up of longer fiber elements. This is also the case with buntal fiber in which the longest fiber elements is found in fibers obtained from the central portion of the petiole, portion C. These are weaker than those from any other portions of the petiole.

Considering more in detail the dimensions of the fiber elements from portions A, B, C, and D of a petiole it should be stated that the length of the fiber cells from each of the portions mentioned, do not vary much. Neither do the length of the fiber elements from the different portions vary appreciably. However, from the average of ten measurements from each portion, the fibers from C (the middle part of the petiole), have the longest fiber elements, 2.1735 millimeters. This is followed in length by the fiber cells from B. In this portion the fiber elements gave an average (from ten readings), of 2.1051 millimeters. The other portions of the petiole have fiber elements,

of 2.0484 and 2.0383 millimeters, in portions A and D, respectively.

The fibers from C (the central portion of the petiole), not only gave the longest average record of the fiber cells, but also gave the widest gross diameter of the fiber from any of the other portions.

3. TENSILE STRENGTH

(*a*) *Of fibers from different petioles.*—Among the good qualities of hats made of fibers from the petiole of buri palm are: white color, fine texture, light, flexible, and durable. Although buntal fiber is well known for its strength and durability, nevertheless, it appears from the results of test of the strength of the fibers obtained from the different petioles of the palm, that the strength of fibers depends upon the position of the petiole on the tree.

It appears that the strength of fibers obtained from the different petioles increases from the oldest petiole up to the fourth petiole, thence strength again decreases gradully as the youngest petiole is approached. As is plainly illustrated in Fig. 1 the strength of the fiber from the youngest petiole (No. 10) is much weaker than that of fibers from the fourth petiole, and even weaker than fibers from any other petiole tested. If the fiber from petiole No. 4 was stronger than those from the older ones, it is probably because the fibers in petioles 1, 2, and 3 were more brittle due to advanced age. If the fibers from petiole 1 be taken as the minimum strength of the fiber that should be collected, it appears that only petioles 1, 2, 3, and 4 inclusive, should be considered as a possible and profitable harvest at any one time. Should the harvest be made earlier than this it would prove not only destructive or harmful to the palm, but also, harmful to the industry. It would be harmful to the plant because of depriving it of sufficient number of leaves to do the normal photosynthetic work. It would be detrimental to the industry because the hats made of weak fibers would not be durable. Such hats put on the market would give a bad reputation to the product.

Perhaps, a safer criterion to use in making a judicious maximum harvest at any one time is the fact that the strongest fiber was obtained from the fourth petiole on the palm, and that the fibers obtained from the inner or younger petioles were weaker. In other words, it appears that the first four petioles should only be harvested at one time, and that about eight opened leaves should be left on the tree. Since Trinidad (3) found

that a buri palm sends out a leaf every month, then the succeeding harvest should be at the rate of about one leaf every month. This leaf would probably give fibers as strong as those obtained from the first fourth petiole.

The data on hand on the stretching ability of fiber of this palm seem to show in a general way, that the strength is correlated with the stretching power of the fiber. This fact further emphasizes the importance of making a judicious harvest in order to obtain the fibers strong and with a high stretching power. The first harvest seems again to point to the first four older leaves and one leaf every month thereafter.

(*b*) *Of fibers from different portions of a petiole.*—As given in Table III the numerical data seem to show that the calculated strengths of the fibers obtained from portions A, B, and C are fairly alike but from portion D, appreciably stronger. The data in Table III also show that there is some relationship between the stretching power and the strength of the fiber. High strength in fiber seems to be accompanied by a corresponding high power to stretch.

4. YIELD OF FIBERS

The fact that buri palm is highly prized as source of the buntal fiber of commerce, and that it requires a number of years before the palm attains the stage when the fibers are extractable from the petioles, makes it rather difficult to secure ample data on the relative yield of fibers of the different petioles of a good-sized palm without sacrificing the latter. Hence the data on hand are rather incomplete. They do not show the yield of fiber of the older petioles as these had already been harvested. Likewise, these data do not include the yield of fiber of the much younger leaves as these were left on the palm in order not to kill it. However, the data on hand though incomplete seem to be worthy of some study.

Examination of the data in Table III shows that the oldest or the first two oldest petioles on a palm are usually long enough to be cut into two pieces. Each piece yields fibers of standard length of 1.3 meters. The amount of fiber, therefore, from long petioles as the ones indicated(b) in the table has doubled or almost doubled that of shorter ones, where two cuts of standard length could not be done.

The data in Table III also show that early injury on the blade of the leaf, results in the failure of the petiole to produce a normal amount of fiber. This case is illustrated by the figures indicated with(c) in the table.

Ordinarily a tree yields in round numbers from about 1,500 to about 2,000 fibers of the standard length each harvest. This harvest is usually practised nowadays in Tayabas, Tayabas; it is rather too heavy. Only three open and two unopen visible leaves are usually left on the palm. The consequence is to slow down the rate of growth of the tree and a corresponding decline in yield of fibers. This heavy harvest should be done only when the trees are to be killed.

IV. SUMMARY AND CONCLUSIONS

1. In this study, careful drawing of buntal fibers as they appear in the different portions of a petiole and of fibers of the palm that were obtained from the market for making hats, are presented. These drawings, together with measurements of dimensions of fiber and of fiber elements, should be valuable contributions to our knowledge of fibers in general and to the buntal fiber in particular.

2. Most of the buntal fibers in the market are vascular bundles. Some of the fine fibers, however, are purely sclerenchyma strands. These should be separated from the coarse vascular bundles, and used as materials in the manufacture of extra-fine hats.

3. Like abaca, the buntal fibers composed of relatively short elements are stronger than those with longer fiber cells. The fibers obtained from the central portion of a petiole are relatively coarse. They are weaker than finer fibers found near or along the outer epidermis of the petiole. The fibers obtained from this part of the petiole may be separated from those obtained from the central portion of the petiole, and should bring a higher price.

4. The fiber from the fourth petiole was the strongest, thence the strength decreases gradually outward and inward, to the oldest leaf and to the youngest visible petiole, respectively. These facts indicate that the proper harvest should be the first four petioles; and one petiole a month thereafter.

V. BIBLIOGRAPHY

(1) ESPINO, RAFAEL B. Abaca Fiber. The Philippine Agriculturist and Forester 4: 179–230. 1916.

(2) MENDIOLA, NEMESIO B. Study of Philippine Bast Fibers. The Philippine Agriculturist and Forester 6: 1–42. 1917.

(3) TRINIDAD, JOSE M. Economic Palms of the Philippines. Thesis presented from the College of Agriculture in 1918. (Unpublished).

GENERAL CHARACTERS OF SOME PHILIPPINE WEED SEEDS [1]

By EDUARDO QUISUMBING, *Department of Plant Physiology, College of Agriculture, University of the Philippines*

INTRODUCTION

Despite the fact that the menace of weeds is present in Philippine agriculture in a most aggravated form, and the losses incurred in consequence of these plant pests are enormous, no serious attention has been given to their eradication. The only method in general use is the most laborious and decidedly ineffective one of uprooting them by hand.

The object of this paper is to furnish knowledge about some of the commonest weeds of the Philippines with regard to their methods of spread and propagation without which they cannot be successfully eradicated by field practice and that farmers may secure pure seed to give a means for detection of weed seeds which may be present in commercial seed. The writer is chiefly concerned in this paper with the description of the seed characters, and only incidentally with habits of the seeds and of the plants.

Extensive work has been done on weeds in the United States, Canada, and other foreign countries, and voluminous literature is now available. The bibliography appended here is by no means complete. (See Pammel, Kellogg, and King.) (31)

The specimens studied were collected for the most part on the farm of the College of Agriculture, Los Baños, and on the farms around Los Baños. The specimens were checked with specimens preserved in the herbaria of the Bureau of Science, Manila, and of the College of Agriculture. These specimens were carefully labeled with the common and scientific names. Dialect names were obtained from the labels of the mounts in the herbaria, and were checked with the information given by the students of the College and by other friends. The identification of these specimens were verified by Mr. E. D. Merrill, formerly Director and Botanist of the Bureau of Science. The synonyms of the scientific names, and other valuable data were

[1] Experiment Station Contribution No. 216.

obtained from Merrill's "Enumeration of Philippine Plants" published by the Bureau of Science.

Each seed was described as carefully as possible, using the external characters which were most evident, with the use of a Bausch and Lomb dissecting microscope. Any ordinary hand lens could have been used for the purpose of identification. As the character can be better shown by drawings than the photographs they were used. The color, size, and shape of the seeds vary considerably according to the age and vigor of the plant, so only mature seeds were selected for comparative study. The measurements given are those of average specimens, in terms of the centimeter scale. The plants are grouped here according to Hooker in his "Flora of British India."

The writer wishes to thank Prof. Henry H. Cowles of the Department of Botany, University of Chicago, for advice and criticism, also to Prof. Charles F. Baker, Dean of the College of Agriculture, University of the Philippines for suggestions.

DEFINITION OF A WEED

A weed may be defined in different ways. Many call it "a plant out of place," while others call it "a wild plant that has the habit of intruding where not desired." Clark and Fletcher (7) define it as "any injurious, troublesome, or unsightly plant that is at the same time useless or comparatively so."

CLASSIFICATION OF WEEDS

Before we can control or eradicate weeds successfully, it is necessary to know the kind of weeds we have to deal with, their characters, habits of growth, life history, and various other things. Commonly speaking, we have two kinds, water weeds and terrestrial weeds. Of these weeds, the latter are the worst enemy of the farmers and the most abundant. Of the water weeds, water hyacinth, *Eichornia crassipes* is the most pernicious. Formerly it was cultivated as an ornamental plant, but through neglect has run wild, and once it gains a foothold in the navigable rivers and lakes it is a most serious problem to check its growth. The water hyacinth is spreading rapidly in the Philippines and is very common along the shores of Laguna de Bay and in the Pasig River, and in some places threatens to halt navigation. Unless measures are promptly taken for its immediate eradication it will soon be impossible to exterminate it except at enormous cost. This particular weed has caused the United States government heavy expenses at various times.

The terrestrial weeds may be further classified in various ways but probably the best scheme is by duration of life. They are either annuals, biennials, or perennials.

Annuals live for only one year, maturing their seeds and then dying. If proper cultural measures are adopted the annuals are the easiest to control. Only a knowledge of their seeding season is essential and necessary for such control. *Portulaca oleracea,* and *Hyptis suaveolens* are examples of these.

Biennials live practically for two years, the first year being given to the vegetative growth and the second to reproduction. There are comparatively few biennials. Some bear seeds in the second year but later turn into perennials.

Perennials are the most abundant and are the worst of all the weeds. They produce great quantities of seeds throughout most of the year, and also may reproduce by vegetative multiplication. The latter is accomplished by the presence of runners or rhizomes.

INTRODUCTION, ORIGIN, AND GEOGRAPHIC DISTRIBUTON OF WEEDS

The history of the introduction of weeds to the Philippines and their origin is an interesting one in many respects. It is, indeed, rather astonishing to find that most of our weeds are of foreign origin and surprising too that most of them are of American origin.

Table I gives a summary of species considered in this paper; a total of 59 species, distributed through 43 genera, and 16 families. Of these 59 species none are endemic. All have been introduced either purposely or accidentally. Of the former there are considered 10 species, two being doubtful, and of the latter 49 species. Of the 59 species, two are cultivated to some extent, one occasionally cultivated, and 56 are spontaneous.

Long before the Philippine Islands were discovered by the Spaniards, the Archipelago was inhabited by people whose exact origin and time of arrival are not well known. And it is rather likely that these early invaders and settlers were the first to introduce cultivated plants into the Philippines, and from the geographical location of the Islands, it may be inferred that most of these plants came from the Malay archipelago, and only a few from the mainland of Asia. With the discovery of the Philippines in 1521 by the Spaniards another period began in which communication was started with tropical America. From this date up to the year 1815 the Archipelago was ruled as a dependency of Mexico. Communication between Mexico

and the Philippines was maintained by means of the state galleons, which sailed annually for Manila, first from Navidad and later from Acapulco. These galleons carried passengers and large quantities of merchandise; unquestionably on these ships many weed seeds of American origin were brought in accidentally in packing materials as "stowaways." During the early days of Spanish occupation many economic plants were brought in by government officials and priests,—abaca (*Musa textilis*), trees yielding resins, timber, gums, etc., and a few palms some bamboos, and some rattans being among the exceptions. Of course with these plants many weed seeds came in accidentally. Of the ornamentals and plants for medicinal purposes some have gone stray and become weeds. Among these, *Argemone mexicana, Mimosa pudica, Indigofera suffruticosa, Cosmos caudatus,* and *Celosia argentea,* are notable examples.

While a great deal has been published on the origin of weeds, comparatively little has been written with regard to the origin of Philippine weeds. To determine the origin of these is no simple task. In many cases there are only vague indications. The evidence from botanical literature is important, but is not sure proof, as a plant may have been described first in Asia, and yet its nativity is not be there. From Table I, it will be found that five species are from Mexico; nine originated from tropical America, excluding those enumerated for Mexico; two native of the Mediterranean region; one from Brazil; three of American origin; two from the Old World; two from India; seven are of Oriental or European origin; and twenty-eight have unknown or doubtful origin.

DISSEMINATION

The ways in which weeds are distributed and scattered are very important factors in control measures.

(1) *By Wind.*—The weed seeds scattered by wind are usually provided with special structures. Some have wings, or coma of hair, or hair-like parachutes, and others are light or small enough to be carried easily by wind though not for great distances. Cogon, talahib, and many of the family Gramineæ, Asclepiadaceæ, and Compositæ furnish examples of wind dissemination.

(2) *By Water.*—A number of our troublesome weeds are transported by water either in ocean currents, creeks, rivers, or irrigation ditches.

(3) *By Animals.*—In this manner of dissemination horses, cattle, carabaos, and other ruminants, and hogs, and dogs play an

important rôle. Seeds are carried in their feet, in the hair and coats, and in some cases pass undigested with the dung. Livestock is commonly responsible for the spread of weed seed from town to town and from one farm to the other. The weeds scattered by animals are often characterized by the presence of a mucilaginous substance on the coats of the nutlets which expands and becomes gummy and sticky when moistened and thus the seeds adhere to the animal's body. Other seeds are provided with hooks, clawed appendages, or spines.

(4) *By Man.*—So far man is one of the most effective and the most rapid agencies in the dispersion of weed seeds. There are several ways by which he disseminates the seeds. (*a*) Walking from field to field in a dewy morning he is apt to carry lots of *Paspalum* spp. and *Hyptis* seeds after the manner of the animals mentioned above. They stick to the clothing and shoes and are dropped when the clothes and shoes get dry. (*b*) Other weed seeds are introduced with nursery stock. (*c*) Many weed seeds are mixed with commercial seeds. (*d*) Many are scattered in the fields with manure. (*e*) A large number are carried and dropped on farms and in towns by means of vehicles, farm implements, and machinery. (*f*) By steamships and railways, they are carried with merchandise.

The following weeds have been inadvertently introduced into the Philippines by man: *Malachra capitata, Cassia tora, Cassia occidentalis, Celosia argentea, Paspalum* spp., *Triumfetta semitriloba, Jussiaea linifolia, Hyptis suaveolens, Ageratum conyzoides, Elephantopus* spp., *Synedrella nodiflora, Panicum flavidum, Achyrantes aspera, Sesbania cannabina, Abutilon indicum* and *Leucas* spp. Those introduced by man either for medicine or for ornamental purposes and which have become weeds are: *Indigofera suffruticosae* for dye; *Mimosa pudica, Cosmos caudatus, Argemone mexicana, Celosia argentea,* and *Malachra capitata.*

(5) *By Birds.*—Migratory birds spread weed seeds, but they also form a factor in the eradication of the weeds as some depend almost entirely for their food on weed seeds.

(6) *By the Plants Themselves.*—Some weeds have fruits with an explosive or ejecting mechanism. Seeds belonging to this category travel only comparatively short distances. The most troublesome weeds are spread by means of runners and rhizomes.

PREVALENCE AND DOMINANCE OF WEEDS

The prevalence of weeds according to Shaw(36) depends upon two factors: "(1) On the number of weed species in any

locality and (2) on the extent to which these various species are allowed to multiply." The extent to which certain troublesome weeds have been allowed to multiply in the Philippines is simply alarming. While some are found only occasionally in the fields, others dominate the locality. This is notably true of *Imperata* spp., *Saccharum spontaneum*, *Andropogon halepensis*, *Ageratum conyzoides*, *Indigofera* spp. Some of these grow so rapidly, that in consequence the cultivation of the land has to be abandoned. They thrive in all fields, crowd every crop, invade gardens, and occupy sides of the roads, often covering the entire road.

The pantropic weeds which form the bulk of the weed flora present in the Philippines remain persistent and are dominant for various reasons. Merrill(25) believes that the dominance is probably due to fundamental differences in the aboriginal floristic conditions. Also they become easily naturalized and have scattered themselves extensively throughout the Archipelago. These weeds are the most difficult to eradicate as many of them have established themselves firmly. To many of these weeds which are drought intolerant, drought is the only check. The rains are responsible for the prevalence and continuous bother of the weeds on the farms and elsewhere. Seeds usually fall off during the drier months and new plants reappear immediately on the arrival of the rainy season. Consequently it is during this season that the weeds are most noxious and troublesome to the farmers. Some weeds like *Andropogon halepensis* var. *propinquus*, *Saccharum spontaneum* and *Imperata* spp. and others belonging to the family Gramineae have deep penetrating root systems with enormous and hardy runners and rhizomes. Shallow plowing cannot kill them and burning which is employed extensively is merely a stimulus to multiplication. Most of our tropical weeds and a few of the pantropic ones owe their dominance largely to the fact that throughout all the year they are continuously developing and maturing seeds. This is a decided advantage in the struggle for existence over the native species which have a restricted period of anthesis.

The viability of weed seeds varies a great deal. Some are susceptible and are easily destroyed in composted manures. Many die through exposure to direct sunlight. Others, however, which have been buried deep in the soil remain viable for some time. These seeds if brought to the surface by plowing germinate in the presence of moisture. In upland fields, caiñgins, and banana plantations, weediness is due to fallowing,

neglect of the land, or improper cultivation. Many seeds which remain in the ground, retain their vitality for years. In the United States experiments have been conducted to determine the vitality of seeds which give astonishing figures. It was found that some seeds retain their vitality after being buried in the soil for fifteen years, and still others remain vital and will germinate after having been buried for twenty-five years.

Another reason for the predominance of weeds on the farm and elsewhere is the natural tendency of some weeds to produce enormous quantity of seeds at one season. Finally, weeds abound and are a menace to farmers because they give no serious attention to eradicating them or carrying out systematic methods for their control.

SOME SMALL BENEFITS OF WEEDS

While weeds are generally considered as useless and troublesome there are a few which render some benefits, but too small to justify their cultivation.

(1) The presence of weeds keeps the farmers at work thus inducing more frequent and thorough cultivation. In some cases, however, the abandonment of farms is attributed to the presence and havoc of weeds.

(2) Some weeds, especially those that are succulent, are used as human food and as feed for animals. *Gulasiman* and *uray* are used by man as salad. As forage, cogon, talahib, agingay, Bermuda grass, *Desmodium* spp. and gulasiman are the most notable.

(3) Some weeds yield bast fibres which are used in the manufacture of sacks; other fibers that may be used as substitutes for jute. *Corchorus* spp., *Sida acuta, Urena lobata, Triumfetta* spp. and *Malachra capitata* are examples of the fibre producing weeds.

(4) Some weeds have useful medicinal properties. *Abutilon indicum, Tinospora crispa,* and *Cassia alata* are examples. Many weeds are used by the native herb doctors.

(5) The essential oils from some weeds are sometimes used to adulterate perfumes. *Lantana camara, Hyptis suaveolens,* and many more belonging to the family Labiatae, are thus used.

(6) Weeds retain moisture and fertility of the soil, in some cases by shading the ground which has been abandoned. They also prevent erosion. The fertility of the soil is undoubtedly increased if leguminous weeds grow in it.

DISADVANTAGES AND LOSSES DUE TO WEEDS

(1) Weeds form the chief crop in the Philippines. This is not generally known, but nevertheless, it is true. It is impossible to say what labor, time, and money are wasted and consumed in futile efforts to keep weeds down. Ordinary cultivation in the Philippines is really a continuous battle with the weeds, which in some cases win and the farmers leave their farms. Some native farmers "fallow" their land as an excuse; but they really surrender to the weeds. This practice is widespread in the Philippines and is detrimental because this "year rest" gives the weeds a splendid opportunity to multiply rapidly. The year following the rest, when he returns to his land, the poor farmer confronts once more his old task now intensified, of battling with the weeds.

(2) *Aeginetia indica* Roxb. (Family Orobanchaceae), is one of the worst weeds in sugar cane plantations. It is parasitic on the roots of the cane plant, and not only affects the well-being of the plant but also reduces the sugar content of the stem, which is an important factor in the sugar industry.

(3) Weeds which intrude themselves in between cultivated plants rob these plants of nutriment. Besides this, they also deprive the plants of a portion of their moisture and sunlight and thus decrease the yield.

(4) Some weeds serve as hosts for certain injurious and destructive insects and fungi. The failure to control and drive out these pests from the farm is due in some cases to weeds. This is true in the case of a hemipterous insect (*Leptocorisa acuta* Thunberg) which affects and attacks the rice during the milky stage of the grains. Also when certain crops are harvested the attacking insects live on various weed plants near by and come out again on the next cultivated crop. A knowledge of these particular weeds is necessary for the control of such insect parasites. The injurious cacao borer works this way. This borer is said to feed on certain wild sterculiaceous plants at first, later turning to the cacao. The same conditions are present with some fungus diseases. The downy mildew of corn, *Sclerospora maydis* is said to be harbored on some wild grasses as well as by corn. Weston(4) found various grasses bearing this fungus. It is very probable that it spends part of its life on some of these grasses when the corn is out of season. The rust on wheat, *Puccinia graminis* is the best and the most classical example of finding weeds hosts. This fungus lives

on the wheat at one season and continues its life on barberry for the other.

(5) Weeds spoil the appearance of a farm and render it less valuable. This statement requires no further explanation. Land foul with weeds sells for less than land clean of weeds.

(6) Some weeds are poisonous, causing the death of animals in pastures and frequently causing colic and digestive troubles.

(7) Some weeds render the milk valueless by an offensive smell.

(8) Some weeds render certain products of the farm unmarketable and reduce their price. This is especially true with *zacate* weeds.

(9) In the case of water weeds many lakes and rivers become choked with them. *Eichornia crassipes,* water hyacinth, is the best example of these.

GENERAL PRINCIPLES FOR THE VARIOUS METHODS OF CONTROL AND ERADICATION OF WEEDS

(1) Prevention is far cheaper than cure; the introduction of weeds into the farm should be prevented so far as possible.

(2) Prevent weeds from seeding on the farm. This is the most important control measure. Mowing, cutting, or pulling up the weeds before they flower or fruit, are effective.

(3) Crop rotation that kills weeds should be encouraged.

(4) Crops should be cultivated throughout the year.

(5) Do not leave any vacant lot in or near your farm uncleaned. Besides giving a chance for the weeds to grow, such a lot makes the place suitable for hosts of insects and fungi.

(6) Pulling up with the hand or digging them up with weeders will rid a lawn of weeds.

(7) Weeds which are already in seed should be cut off and burned.

(8) Deep plowing may be practiced. This will bury the seeds deeper; and some seeds lose their vitality when buried deeper in the soil. Deep plowing for this purpose should be followed by fallowing.

(9) Turning land to pasture is also an effective means of combating some noxious weeds.

(10) In general, a weed law is desirable. There is no such law in the Philippines and one should be enacted. Such a law should fake weeding coöperative and effective, as it is in the United States and other countries, and provide penalties for

allowing lands to become foul with weeds and thus serve as sources of weed invasions.

(11) Control of weeds by chemical means. No experiments along this line have been conducted yet in the Philippines.

(12) Burning lands infested with weeds has certain limitations and should be used cautiously. Burning "cogon lands" and "talahib patches" tends to stimulate the multiplication of the plants.

(13) All weeds should be removed from the fields, carried away, and not allowed to grow. The common practice of cutting *gulasiman* and allowing it to stay in the fields merely induces rapid multiplication.

(14) Plant clean seeds only.

(15) Above all, the careful study of the habits of growth, life history, and methods of propagation is a most important factor in weed eradication. There should be an educational campaign on weeds in the Philippines before it is too late, and courses for the study of weeds should be established in the schools of the Islands.

GRAMINEAE

COIX LACHRYMA-JOBI Linn. (Plate XXVII, fig. 1.)

Coix lachryma Linn.
Coix agrestis Lour.
Coix exaltata Jacq.

Local names: abúkai (Iv.); adlái (Bis.); agagay (Iv.); apági (Ig.); attakay (Ilk.); kalabúgau (Bud.); katayán (Ig.); kudlásan (Tag.); lamúdias (P. Bis.); paliás (P. Bis.); painás (P. Bis.); tidbi (S. L. Bis.); tigbí (Tag.). It is known in the United States by the names: Job's tears and sometimes as Christ's tears.

Fertile spikelets ovoid, acuminate. Seed ovoid, hard, bony, white or nearly black, shining, 8–10 mm. long and 5–7 mm. wide.

Throughout the Philippines in settled areas at low and medium altitudes, in most or all islands and provinces. Very common along fences whether cultivated or escaped. It is cultivated in all tropical countries for ornament, and sometimes in the open, and in green-houses in warm temperate regions. The fruits or the so-called seeds are used as beads, and for rosaries. Certain varieties (adlay) are used as grain food by various pagan tribes. It was one of the first plants introduced, because it was known to the original invaders, the Malayans. Purposely introduced for ornamental purposes. It is a native of the Old World, now pantropic.

Field No. 1615.

IMPERATA CYLINDRICA (Linn.) Beauv. (Plate XXVII, fig. 2.)
Saccharum koenigii Retz.
Imperata koenigii Beauv.
Imperata arundinacea Cy.
Imperata arundinacea Cyr. var. koenigii Benth.
Saccharum spicatum Presl.
Local name: Kogon (Tag., Bis., Sul. Ilk., Bik.).

The spikelets are long and lanceolate; base surrounded by silky white hairs; glumes membraneceous. Seeds light brown to brown, tapering, lanceolate, surface smooth, shiny, 0.09–1.00 mm. long. 0.25–0.30 mm. wide.

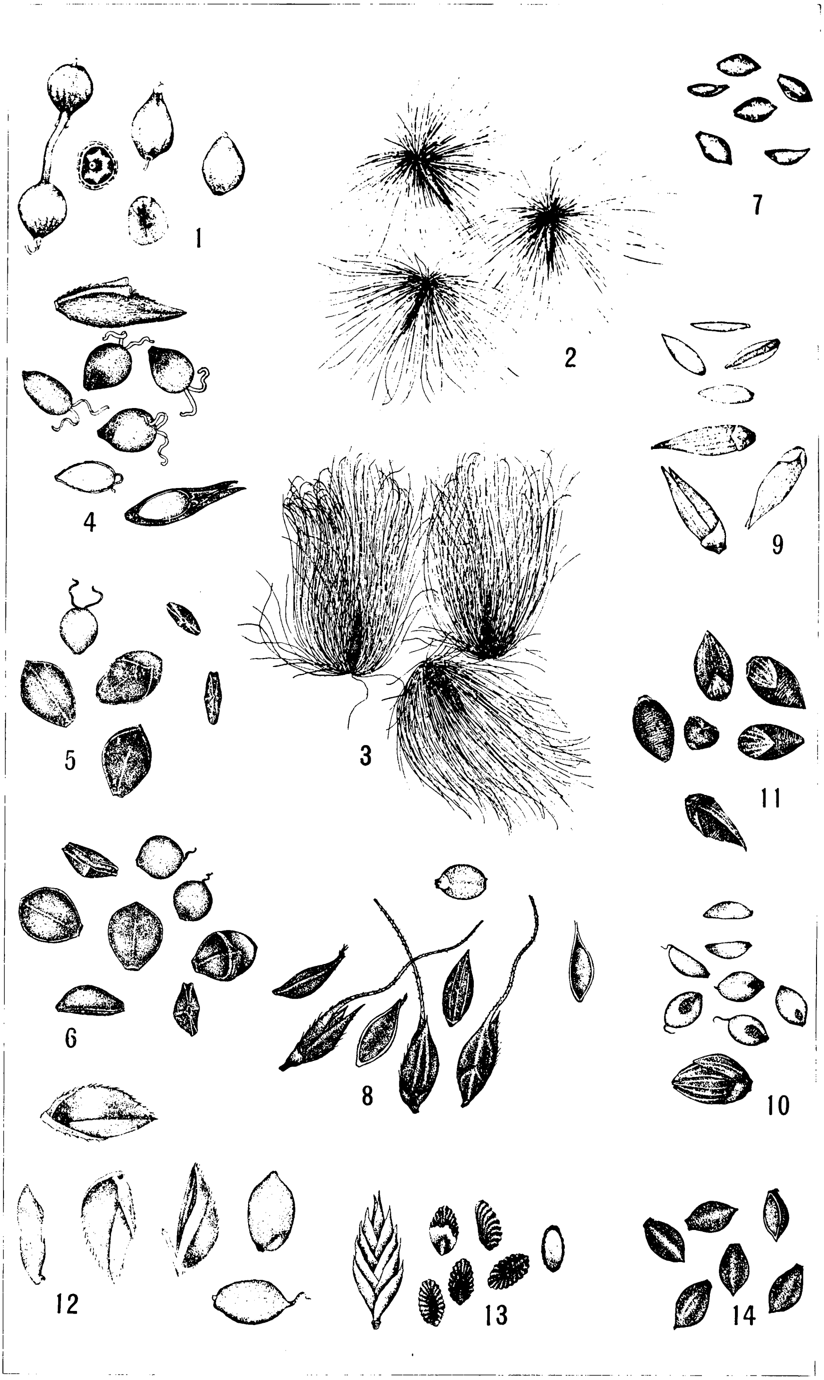
Very common in Central Luzon, to Palawan and Mindanao. The rhizomes and runners are very well developed. Runners measured ran as far as one meter, and may even go farther if the soil is loose and loamy. These runners have the peculiarity of penetrating even the hard adobe soils. Such penetration is only possible by means of very sharp needle-like ends of the runners, which are well protected with scales. From the runner a new plant may arise. It is a hardy perennial, and this accounts for the difficulty of exterminating it. The plant is extremely xerophytic, and is able to grow in adobe soils and among rocks, on exposed ridges, and luxuriantly on the dikes of rice paddies. Burning cogon lands, which is often practised to kill the cogon is never effective; instead it tends to produce new shoots and new plants. Aside from vegetative means of propagation; seeds also act as very good medium for dispersal. The seeds are light, and are easily blown by the wind on account of the long, silky, white hairs surrounding the base of the large empty glume.

As a weed it is hard to combat, and the only way to control it is by repeatedly plowing the land, or by planting in the land some leguminous plants such as Ipil-ipil, *Leucaena glauca*. Other legumes may be planted in cogon patches instead of Ipil-ipil, but few can surpass the latter, as Ipil-ipil not only suffocates the cogon but after several years gives a valuable supply of firewood. Cogon is the worst weed in *Caiñgins,* and newly cultivated areas. Sweet potatoes planted in cogon areas, a practice of the mountain people, does not yield as good a crop, as very often the tubers are pierced by the runners.

Though this plant is such a terrible weed, yet it is an indispensable plant to the barrio and mountain people. It is the source of material for thatching roofs and walls of houses. Not only barrio people make use of the leaves this way, but likewise

PLATE XXVII

FIG. 1. Seeds of *Coix lachryma-jobi* L. Natural size.
2. Seeds of *Imperata cylindrica* (Linn.) Beauv. × 10.
3. Seeds of *Saccharum spontaneum* L. subsp. *indicum* Hack. × 10.
4. Spikelets and Seeds of *Andropogon halepensis* (Linn.) Brot. var. *propinquus* (Kunth). × 5.
5. Florets and seeds of *Paspalum longifolium* Roxb. × 5.
6. Florets and seeds of *Paspalum scrobiculatum* Linn. × 5.
7. Seeds of *Panicum colonum* Linn. × 5.
8. Spikelets, florets, and seed of *Panicum crus-galli* Linn. × 5.
9. Florets and seeds of *Panicum repens* Linn. × 5.
10. Florets and seeds of *Panicum flavidum* Retz. × 5.
11. Florets of *Setaria geniculata* (Lam.) Beauv. × 5.
12. Florets and seeds of *Cynodon dactylon* (Linn.) Pers. × 5.
13. Spikelet and seeds of *Eleusine indica* (Linn.) Gaertn. × 5.
14. Nutlets of *Cyperus difformis* Linn. × 10.


1
2
7
4
9
5
3
11
6
8
10
12
13
14

the town people where the price of corrugated iron is beyond the reach of the poor. In arid lands, and lands practically impossible for agriculture the young growth of cogon supplies good forage to cattle and carabaos. Most pastures in the Philippines are made up largely of cogon grass. Richmond's (33) results on the suitability of cogon leaves for paper making show that they will make the cheaper grades of printing paper. Accidentally introduced? Spontaneous. Origin unknown. Distributed through Malaya, Africa, tropical Asia, Australia and Polynesia.

Field No. 1623.

SACCHARUM SPONTANEUM Linn. subsp. indicum Hack. (Plate XXVII, fig. 3.)

Saccharum spontaneum Linn.

Saccharum spontaneum Linn. subsp. luzonicum Hack.

Anthistiria gigantea Blanco.

Saccharum insulare Brongn. var. amplum et var. depauperatum Anders.

Local names: Bugáng (C. Bis.); liddá (Ilk.); sálin (Bon.); taláhib (Tag.); tigbau (S. L. Bis., P. Bis.).

This is a perennial with spikelets very similar to those of sugar cane, surrounded by numerous villous hairs, to twice their length. Unlike sugar cane, a large proportion of the seeds are viable and fertile. The seed surrounded by empty glumes is very small, light reddish brown, the apical end being darker in color; 1.2–1.5 mm. long, 0.4–.5 mm. wide, oblong, acute, surface more or less shiny and smooth, with faint parallel ridges.

It is found throughout the Philippines, in open areas at low and medium altitudes, ascending to 1,500 meters. Like cogon it is a drought resistant grass. It is seldom found on dikes of rice paddies. It is often gregarious and almost exclusively occupying large areas. It is a very common and bothersome weed in sugar cane plantation often overgrowing the young sugar cane seedlings. It is also often found invading corn fields, and is the worst weed of the banana plantations. It is very persistent and difficult to eradicate. Shallow plowing, cutting or burning, do not appear to decrease its growth but to improve its yield. Its persistence is due to its well developed root system and the presence of strong and hardy rhizomes. The most prominent method of dissemination is by means of seeds. The seeds are blown by the wind to a considerable distance, due to hairs at the base of the outer empty glumes. The leaves are not as useful as cogon leaves. Occasionally the young leaves are

eaten by carabao and cattle. It is as aggressive as the Johnson grass, and should not be allowed to remain in and around fields. It flowers from September to November, and also from April to June. India to southern China through Malaya and Polynesia. Accidentally introduced. Spontaneous. Origin unknown.

Field No. 1640.

ANDROPOGON HALEPENSIS (Linn.) Brot. var propinquus (Kunth) Merr. (Plate XXVII, fig. 4.)

Andropogon propinquus Kunth.
Andropogon affinis Presl.
Sorghum halepense Pers. var. muticum Nees.
Sorghum halepense Miq.
Andropogon sorghum Pers. subsp. halepensis Hack. var. propinquus Hack.

Local names: Aroró (Bik.); batad-batádan (Tag.); sikal (Ibn.); gingai (Bag.); riaría (Sul.); uginai (Buk.).

Spikelets numerous, in pairs, one sessile and firtile, the other pedicellate, oblong-ovoid, pubescent, greenish or purplish. Empty glumes surrounded on the surface with bristly hairs. Seeds plano-convex, oval to oblong, tapering, brown, rather smooth 1.9–2.1 mm. long, 1.0–1.5 mm. wide.

The plant is found scattered from the Batanes and northern Luzon to Mindanao, in most or all islands and provinces. Spontaneous. It is a perennial with solid clumps, and stout creeping rhizones, and flowering most of the year. It is the most troublesome weed of sugar cane and corn fields. It is often used as forage grass, but the difficulty of eradicating it offsets its forage value. Some poisoning of cattle and carabaos in ranges and pastures may be due to the second growth of this grass, which is often quite rich in hydrocyanic acid. It is such a hardy weed, and such a persistent occupant of the soil that means for its eradication should be immediately undertaken. For methods of eradication see Cates and Spillman (6). It propagates by seeds, and by stout creeping rhizomes,

The species is pantropic, the variety occurring from Ceylon to New Guinea. Accidentally introduced. The species is native of the Mediterranean region. The nativity of the variety is doubtful.

Field No. 1643.

PASPALUM LONGIFOLIUM Roxb. (Plate XXVII, fig. 5.)

Paspalum flexuosum Klein.

Local name: taltal-likód (Ilk.).

The spikelets are obovoid, somewhat compressed, subsessile, solitary, alternating on the rachis. Florets elliptical, flat on

one side and convex on the other, obtuse, straw colored, 2.0–2.6 mm. long, 1.4–1.8 mm. wide; "hull" with fine uniform ridges on the outside surface. Seed plano-convex, ovate, light srtaw, shining and somewhat pitted, nearly smooth.

Luzon (Cagayan, Benguet, Bontoc, Nueva Vizcaya, Bulacan, Rizal, Laguna, Albay) Polillo, Palawan, Bohol, Mindanao. It is common in the open, usually in the wet lands at low and medium altitudes, especially in the rice paddies. Spontaneous. It is a perennial grass, flowering all the year around, usually found colonized in the rice paddies and in wet places. It is not a pernicious weed, but its presence impairs the price of "*zacate,*" and very often crowds the young rice seedlings. The roots are rather fibrous and numerous but more or less superficial and easily pulled. Seeding is the only method of reproduction. Inadvertently introduced by man. India to Malaya. Origin unknown.

Field No. 1616.

PASPALUM SCROBICULATUM Linn. (Plate XXVII, fig. 6.)

Paspalum cartilagineum Presl.
Paspalum kora Willd.
Paspalum villosum Blanco.
Paspalum sumatrense Roth.
Paspalum thunbergii Kunth.

Local names: añgangsúg (Ig.); bias-biásan (S. L. Bis.); sabung-sabúñgan (Tag.).

Florets plano-convex, brown to dark brown, with the same characteristic strations on the surface as in *Paspalum longifolium,* 1.0–2.2 mm. long, 1.4–1.6 mm. wide, with a prominent longitudinal ridge on the middle. Seed plano-convex, nearly rotund, very light brown, smooth, shiny, 1.–.3 mm. in diameter.

Throughout the Philippines, in open grasslands at low and medium altitudes, ascending to 1,500 meters. A very common weed in banana plantations, and along country roads. Spontaneous. It is a perennial and flowers all the year. It is scattered by means of seeds. Men carry these seeds unconsciously on their shoes and trousers during dewy morning when grasses are wet, and crop them along the road and in the fields when they get dry. Animals scatter them in a similar way by their feet and hair. They find place to cling on wetted implements of the farm particularly plows and harrows. When forage is scarce, this grass is often eaten by horses and cattle and carabaos. Where other good grasses are available, animals do not usually eat this grass, probably because of its rather bitter

taste. It is not as noxious as Cogon or talahib, and people usually allow it to grow and multiply unhindered. Though this grass keeps the sides of the roads weedy, it prevents erosion of the roads. It is very common too in dikes of rice paddies, but does not interfere with the rice plants. Accidentally introduced? Its origin is not known. Pantropic in distribution.

Field No. 1126.

PANICUM COLONUM Linn. (Plate XXVII, fig. 7.)

Panicum colonum Linn. var. pseudocolonum Nees.
Panicum cumingianum Steud.
Echinochloa colona Link.
Oplismenus colonus HBK.
Orthopogon dichotomus Llanos.

Local names: Búlang (Tag.); dakayáng (Ilk.); dukayáng (Ilk.); tiribúhan (Tag.); tumi (Bon.).

Florets elliptical, plano-convex, apex pointed, highly polished, greenish or purplish, 3 slender light colored nerves join the extremities, 2.0–2.2 mm. long, 1.0–1.2 mm. wide.

Found throughout the Philippines, at low and medium altitudes, in the open, in rather wet places, on roadsides, and in rice paddies. It flowers throughout the year. Spontaneous. This grass is not a very noxious weed, but its multiplication should be discouraged. It has been found that at seasons when rice plants are not growing, this weed, which is an annual, supplies food to the hemipterous insects "atangia," (*Leptocorisa acuta* Thunberg.) which attack the rice kernels during the milky stage. Its eradication therefore should be encouraged. In open waste places it serves as a forage grass. It propagates by seeds, which are carried either by man or birds. Accidentally introduced? Origin, unknown. Pantropic.

Field No. 1124.

PANICUM CRUS-GALLI Linn. (Plate XXVII, fig. 8.)

Oplismenus limosus Presl.
Panicum limosum F.-Vill.
Panicum hispidulum Lam.
Echinochloa crus-galli Beauv.
Orthopogon hispidus Spreng.
Orthopogon subverticillatus Llanos.

Local names: Baobao (If.); daua-daua (Tag.); dauadauáhan (Tag.); dauana (Mbo.); sabsablúg (Bon.); sabsábug, (Bon.); barnyard grass (Eng.).

The spikelet is one-seeded, nearly sessile, elongate-ovate, often long awned, 3.8–4.4 mm. long, 1.4–1.5 mm. wide; glumes unequal,

sharp pointed, and bristly-hairy. Florets lanceolate, tapering, white to yellowish gray or brown, plano-convex, polished, with three distinct longitudinal nerves on the convex side. The seeds oval, plano-convex, flat side nearly shrunken, gray brown to straw colored, with very shallow longitudinal striations, 1.5–1.6 mm. long, 1.0–1.2 mm. wide.

Found throughout the Philippines at low and medium altitudes in open wet places, rice paddies, etc. It flowers all the year. *Panicum crus-galli* Linn. var. *muticum* Doell. is found in Luzon (Bontoc, Benguet, Rizal), Balabac, and Palmas. Spontaneous. Daua-daua is a noxious weed in rice paddies, and especially in *Zacate* fields. Zacate mixed with such grass sells for less and is not well liked by horses. Such impurities in Zacate can be avoided if these plants are pulled out of the fields before cutting the Zacate. It is an annual grass, and matures earlier than rice. Some farmers purposely allow such grass to grow side by side with rice, and it is said to drive the birds away, because of the long awns of the spikelets, and thus protect their rice fields from the attack of birds. If such purpose is justified, it is the best use of the plant; but I have seen rice fields overgrown by this weed, allowing no chance even for the rice plants to develop at all well. The only method of reproduction is by seeds. Seeds usually fall off before the rice is harvested and stay on the ground the whole season. When the fields are plowed, the seeds are turned under, but they have a remarkable vitality, and may grow after a certain period of dormancy. To prevent seed ripening is most essential, and this can be done by pulling the plants before the seeding season. Found in all warm countries, and in the United States. A native of America. Accidentally introduced.

Field No. 1630.

PANICUM REPENS Linn. (Plate XXVII, fig. 9.)

Panicum ischaemoides Retz.
Panicum convolutum Beauv.
Panicum tuberosum Llanos.
Panicum miliare Mez.

Local names: Kayana (Mbo.); luya-luyáhan (Tag.).

Rootstocks stout. Stem somewhat prostrate or creeping. Florets oblong-ovate, acute or slightly acuminate, white, smooth, rather shining, with faint longitudinal striations, 2.3–2.5 mm. long. 0.5–0.8 mm. wide. Very common throughout the Philippines, flowering all the year, in open low lands,

especially near the sea, but also inland locally and ascending to 1500 meters. Seldom a troublesome weed. Reproduced by seeds. A fine forage grass, and is often eaten voraciously by carabaos. Spontaneous. Accidentally introduced? Origin unknown. Pantropic.

Field No. 1644.

PANICUM FLAVIDUM Retz. (Plate XXVII, fig. 10.)

Panicum floridum Usteri.

Local names: Giling (C. Bis.); sabung-sabuñgan (Tag.).

Florets light yellow to yellow, very pale, oval to ovate-lanceolate, apex pointed, obtuse, with fine longitudinal striations, shining, 2.5–3.0 mm. long, 1.2–1.4 mm. wide.

Throughout the Philippines from northern Luzon to Palawan and Mindanao. A common weed in open waste places in and about towns at low altitudes. It flowers all the year. It is not as troublesome as *P. colonum* and practically has the same habits. It is also eaten by animals and constantly scattered by them. Reproduced by seeds.

Accidentally introduced. Spontaneous. Origin unknown. Tropical Asia, Africa, and Malaya.

Field No. 1669.

SETARIA GENICULATA (Lam.) Beauv. (Plate XXVII, fig. 11.)

Panicum flavum Nees.
Panicum geniculatum Lam.
Panicum penicillatum Nees.
Setaria flava Kunth.
Panicum chrysanthum Steud.
Panicum rubiginosum Steud.
Setaria aurea Hochst.
Setaria pilifera Naves.
Setaria glauca F.-Vill.
Chaetochloa glauca Scribn. var. aurea W. F. Wright.
Setaria glauca Beauv. var. aurea K. Schum.
Setaria rubiginosa Miq.
Chaetochloa geniculata Millsp. and Chase.

Local names: Buntot-púsa (Tag.); putiñgán (Ig.); sabsablúg (Bon); samsamáng (Bon.); tirtirígo (Ilk.).

Spikelets light yellow, purplish, orange, or violet at the apices, surface of glume with fine longitudinal striations, 2.0–2.3 mm., long, 1.0–1.2 mm. wide. Seeds plano-convex, oval, very small, light straw colored.

Found throughout the Philippines, flowering from July to December, in open grasslands at low and medium altitudes, ascending to 1,800 meters. It is an annual, and is scattered and propagated by seeds. Spontaneous. Birds, carabaos, and

cattle scatter the seeds, either passing with the dung and undigested or attached to the skin or feet. The seeds are often found as an impurity in commercial seeds. Pantropic. Origin doubtful. Accidentally introduced.

Field No. 1619.

CYNODON DACTYLON (Linn.) Pers. (Plate XXVII, fig. 12.)

Panicum dactylon Linn.
Cynodon linearis Willd.
Panicum glumaepatulum Steud.
Digitaria glumaespatula Miq.
Cynodon rufescens Llanos.
Capriola dactylon O. Kuntze.

Local names: Galudgalud (Ilk.); grama (Sp.); palot-galot (Ilk.). Commonly known in the United States as Bermuda grass. Also known as wire grass, reed grass, and dog's-tooth grass by American farmers. It is recognized as Bahama grass in the West Indies, and Manienie in the Hawaiian Islands.

The spikelets imbricate, awnless. The florets smooth, very light straw in color, acuminate; lemma compressed, pubescent on the keel, 3.0–3.8 m. long 1.0–1.8 mm. wide. Seed (grain) oblong, apex tapering light brown, nipple at large end, 2.4–3 mm. long, 1.3–1.5 mm. wide.

Very common throughout the Philippines in open grasslands, fallowed rice fields, waste places, fields and meadows, at low and medium altitudes. It flowers all the year. This grass is used quite extensively in the making of lawns; in fact it is one of the best grasses for tropical lawns. It becomes pestiferous in the fields where it can creep and grow fast and freely. It is a perennial, and is spread chiefly by the hard coarse stolons and rhizomes. It is seldom reproduced by seeds. Because of the creeping habits of the rhizomes, it is hard to control unless the whole plant is pulled out by the hands or hoed out. It is not however a very destructive weed. Purposely introduced for lawn work. Pantropic. Native of the Mediterranean region.

Field No. 1636.

ELEUSINE INDICA (Linn.) Gaertn. (Plate XXVII, fig. 13.)

Cynosorus indicus Linn.
Eleusine barbata Vidal.
Eleusine polydactyla Steud.

Local names: Bilabila (P. Bis.); kabit kabit (Tag.); parangis (Ilk.). In the United States it is known by the names of goose-grass, yard grass, wire grass, crab-grass, crow-foot grass, and Indian Eleusine.

Spikelets compressed, sessile, closely imbricate. Glumes unequal, acute. Lemmas acute with 3–5 nerves. The pericarp

of the seed (grain) very light straw color, membraneous, loosely inclosing the seed. Seed dark reddish grown, rugose, roughened, by fine ridges, ovoid with base pointed or rounded, 3 sided, corners rounded, ventrae with groove, ridges 9–15, 1.2–1.6 mm. long, 0.5–0.6 mm. wide.

An abundant weed in the settled areas througout the Philippines, on the roadsides, in farm yards, and in waste places. Spontaneous. It is an annual, spreading, and prostrate. It destroys the beauty of the lawns and should be hand-pulled or hoed out immediately, before it develops seeds. It is reproduced chiefly by seeds. Probably introduced during prehistoric times. Found in all warm countries, and throughout the warmer parts of America. Of Oriental or European origin.

Field No. 1122.

CYPERACEAE

CYPERUS DIFFORMIS Linn. (Plate XXVII, fig. 14.)

Cyperus subrotundus Naves.
Cyperus goeringii Steud.

Local names: Baki-baki (Bis.); ballayang (Ilk.); pukuugan (Bon.).

An annual rice paddy weed. Spikelets very numerous. Nutlets very small, very numerous, light straw color, somewhat elliptical, with acute apex, rather papillate base, surface slightly roughened with very minute tubercles, angles obtuse, ridge on dorsal surface prominent, ventral portion flat, transverse section of the nutlet 3 angled, 0.06–0.08 mm. long, 0.025–0.04 mm. wide.

It is found throughout the Philippines in open wet places ascending to 2,000 meters; a characteristic rice paddy weed. Flowers all the year. Accidentally introduced. Spontaneous. Evidently not a very troublesome weed. Spreads by means of its very tiny seeds, (nutlets.) Origin doubtful. Old World tropics generally, introduced in Mexico.

Field No. 1116.

CYPERUS IRIA Linn. (Plate XXVIII, fig. 15.)

Cyperus nattallii Llanos.
Chlorocyperus iria Rikli.

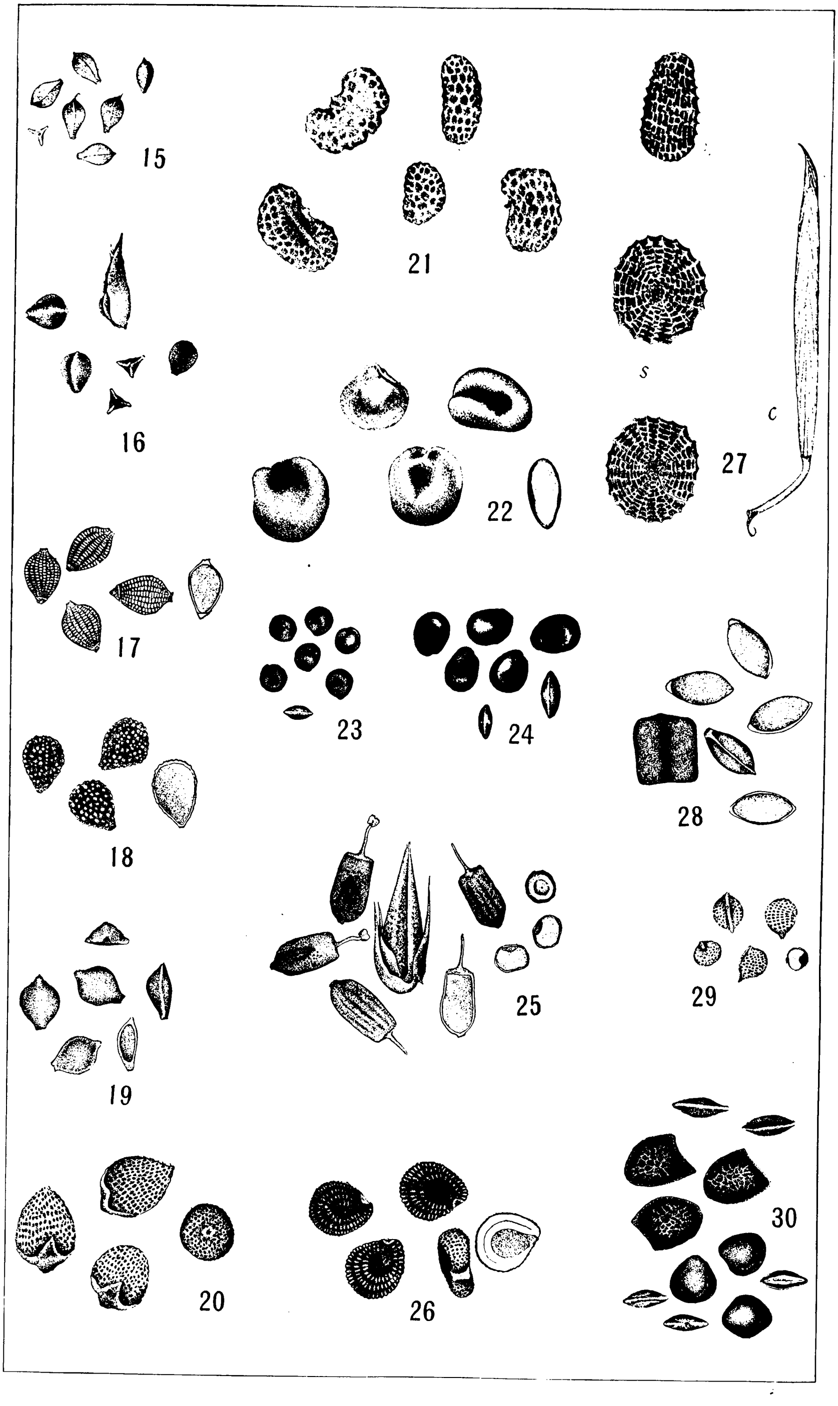
Local name: Okokiang (Bon.).

An annual. Spikelets numerous, glumes obovate, hardly imbricate. Nutlets light reddish brown to dark brown, oblong-ovate, prominently 3-angled, faces more or less convex, majority flat, or slightly concave, somewhat smooth and shining, apex papillate, acute, base obtuse, or nearly truncate, 1.2–1.5 mm. long, 0.05–0.08 mm. wide.

PLATE XXVIII

FIG. 15. Nutlets of *Cyperus iria* Linn. $\times$ 5.

16. Spikelet and nutlets of *Cyperus compressus* Linn. $\times$ 5.
17. Nutlets of *Fimbristylis annua* (All.) R. & S. $\times$ 10.
18. Nutlets of *Fimbristylis miliacea* (Linn.) Vahl. $\times$ 10.
19. Nutlets of *Scirpus grossus* Linn. $\times$ 5.
20. Nutlets of *Scleria scrobiculata* Nees. $\times$ 5.
21. Seeds of *Commelina benghalensis* Linn. $\times$ 10.
22. Seeds of *Celosia argentea* Linn. $\times$ 10.
23. Seeds of *Amaranthus spinosus* Linn. $\times$ 5.
24. Seeds of *Amaranthus viridis* Linn. $\times$ 5.
25. Seeds of *Achyranthes aspera* Linn. $\times$ 5.
26. Seeds of *Portulaca oleracea* Linn. $\times$ 10.
27. Capsule, c($\times \frac{2}{3}$) and seeds, S($\times$ 10) of *Gynandropsis gynandra* Linn.
28. Seeds of *Jussiaea linifolia* Linn. $\times$ 10.
29. Seeds of *Argemone mexicana* Linn. $\times$ 10.
30. Seeds and portion of pod of *Mimosa pudica* Linn. $\times$ 2.5.


15
16
17
18
19
20
21
22
23
24
25
26
s
c
27
28
29
30

A very common weed in open wet places throughout the Philippines; a very common and characteristic rice paddy weed. It is also found infesting lawns. Flowers all the year. Accidentally introduced. Spontaneous. Propagates by means of nutlets. Origin unknown. Old World tropics generally.

Field No. 1659.

CYPERUS COMPRESSUS Linn. (Plate XXVIII, fig. 16.)

Cyperus humilis Llanos.
Cyperus compressus Linn. var. brachiatus Nees.
Cyperus meyenii Nees.

Local names: Ananá (Ibn.); gísai-kalabau (Tag.); kaptos (Iv.); túhog-dalág (Tag.).

An annual. Spikelets greenish, 1 to 3 mm. long, flowering glumes prominently acuminate, much longer than the nuts, densely imbricate. Nutlets grayish brown to reddish brown, darker at the middle of the faces, obovoid, apex truncate with almost obscure nipple, base truncate and tapering, sharply 3-angled, surface flat to nearly concave, smooth, 1.2–1.5 mm. long, 1.0–1.2 mm. wide.

Very common throughout the Philippines in open grasslands, waste places, etc., at low and medium altitudes. Abundant too in rice paddies. Not a very pernicious weed. Flowers from July to January. Propagates by the agency of nutlets. Origin doubtful. Spontaneous. Accidentally introduced. Pantropic.

Field No. 1613.

FIMBRISTYLIS ANNUA (All.) R. & S. (Plate XXVIII, fig. 17.)

Scirpus annuus All.
Scirpus diphyllus Retz.
Fimbristylis diphylla Vahl.
Fimbristylis tomentosa Vahl.
Fimbristylis brizoides Sm., var., Nees.
Fimbristylis philippica Steud.
Fimbristylis communis Kunth.
Fimbristylis affinis Presl.
Scirpus falcatus Llanos.
Fimbristylis dichotoma C. B. Clarke.

Local names: Baliótas (Bag.); bubáging (Sub.); gilal (Sub.); tabtábin (Sbl.); talágig (Bag.); tayok-táyok (Sbl.).

Spikelets pedicelled, some sessile, brown ovoid. Nutlets same color as in *Fimbristylis miliacea,* oblong-ovoid to obovate, distinctly longitudinally striated, 8 striations on dorsal surface, convex, flat with 6 striations ventrad, shining, apex

papillate, striations distinguishing character from *F. miliacea.* 0.9–1. mm. long, 0.4–1.6 mm. wide.

Throughout the Philippines in open waste places at low and medium altitudes, abundant and variable; in the Philippines various forms or varieties occur that have been characterized as species. Quite common in rice paddies and in lawns, not pestiferous. Flowers all the year. Accidentaly introduced. Origin unknown. Spontaneous. Pantropic.

Field No. 1115.

FIMBRISTYLIS MILIACEA (Linn.) Vahl. (Plate XXVIII, fig. 18.)

Scirpus miliaceus Linn.
Scirpus niloticus Blanco.
Trichelostylis miliacea Nees. & Arn.
Isolepis miliacea Presl.

Local names: Agor (Tag.); gúmi (Pang.); sirau-sirau (Ilk.); sirisi-búyas (Bik.); taulat (Tag.); ubod-úbod (Tag.).

An annual. Umbels decompound. Spikelets small, obtuse, globose, pale or brown, mostly slenderly pedicelled, some sessile. Nutlets somewhat hyaline, quite light yellowish, obovoid, base rounded, apex tapering, not acute, surface roughened, tuberculate, prominent, 0.6–0.9 mm. long, 0.4–0.5 mm. wide.

Very common throughout the Philippines in open wet places; a characteristic rice paddy weed. Not harmful. Flowers throughout the year. Accidentally introduced? Spontaneous. Origin unknown. Pantropic.

Field No. 1120.

SCIRPUS GROSSUS Linn. (Plate XXVIII, fig. 19.)

Cyperus difformis Blanco.
Scirpus kysoor Roxb.
Scirpus grossus Linn. f. var. kysoor (Roxb.) C. B. Clarke.
Schoenoplectus grossus Palla.

Local names: Balakbák (Pang.); ragiudiu (Bik.); tíkiu (Tag.).

Perennial. Spikelets numerous, brown, ovoid. Nutlets light brown, broadly elliptical, surface shining, very minutely tuberculate (almost inconspicuous, apex somewhat truncate, base obtuse, 3-sided, dorsal ridge very prominent and sharp, sides somewhat convex, often flat, dorsal face flat to nearly concave, 1.4–1.6 mm. long, 1.0–1.2 mm. wide. Scattered from central Luzon, to Mindanao, in most islands and provinces. Very common weed in open fresh water swamps, along streams, and especially abundant in rice paddies, and abandoned rice fields. It forms the most dominant vegetation of the swamp shore of

Laguna de Bay near the Crocodile Lake, Los Baños. Accidentally introduced? Origin doubtful. Spontaneous. Propagates by means of seeds and rhizomes. Flowers from May to November. India to Indo-China and Malaya.

Field No. 1660.

SCLERIA SCROBICULATA Nees. (Plate XXVIII, fig. 20.)

Scleria foveolata Llanos.

Scleria multifoliata C. B. Clarke.

Local names: Agagidán (Bon.); aladán (Ilk.); amamgid (Ilk.); amgid (Tag.); árat (Pamp., Tag.); dáat (Tag.); dát (Pamp., P. Bis.); dáut (Tag.); gáat (Iv.); haras (P. Bis.); katabad (Tag.); katabot (Tag.); mangked (Iv.); tangra (Ilk.); ulat (Pang., Tag.).

Perennial. Spikelets brownish-purple, numerous, scattered or slightly clustered. Nutlets white, globose, bony, deeply pitted, pits arranged more or less spirally, apex acuminate, shining, gynophore usually prominent under the nutlet, 3.0–3.5 mm. long, 2.0–2.4 mm. wide.

Throughout the Philippines, in thickets, open places, old clearings, etc., at low and medium altitudes. A very common weed in "caiñgin" clearings. The leaf blades are sharp, and easily cut the skin on contact. It is not eaten by animals on account of the coarse leaves. Reproducer by seeds. Accidentally introduced? Spontaneous. Origin unknown. Flowers most of the year. Andaman Islands to Riu Kiu, southward to New Guinea.

Field No. 1645.

COMMELINACEAE

COMMELINA BENGHALENSIS Linn. (Plate XXVIII, fig. 21.)

Commelina polygama Blanco.

Local names: Alikbáñgon (Tag.); kuhási (Iv.); kulkul-lási (Ilk.).

Prostrate or ascending succulent herb, flowers blue, capsules 4–5 cm. long, loculicidal, cleistogamous flowers are usually at the lower nodes, ripening capsules on the surface of or below the ground. Seeds dark brown, kidney-shaped, one side truncate, scar (hilum) prominent, whole surface prominently rugose, and deeply pitted, pits about 0.3 mm. wide, pericarp hard, 2.0–2.3 mm. long, 1.4–1.6 mm. wide.

Found throughout the Philippines in open grass lands, and waste places in the settled areas at low and medium altitudes, often common. Quite abundant in neglected banana plantations. Not very noxious weed. Stems rooting at the nodes, is one of the active means of propagation, especially if left in the fields after the cutting or hoeing. It is also reproduced

by seeds. Flowers all the year. Accidentally introduced? Spontaneous. Origin unknown. Tropical Africa and Asia to Japan and Malaya.

Field No. 1651.

AMARANTHACEAE

CELOSIA ARGENTEA Linn. (Plate XXVIII, fig. 22.)

Local names: Kadadohan (Tag.); lofoi (Ilk.); sansandók (Ilk.); taguhug (P. Bis.).

An annual, erect, simple, or branched herb. Spikes solitary, erect, stout, dense, white or pink, ovoid to oblong, linear. Flowers white or pale pink, shining. Seeds black, highly polished, smooth, orbicular, usually compressed, 1.0–1.2 mm. in diameter.

Very common weed throughout the Philippines at low and medium altitudes in the settled areas, and fallowed lands. Very abundant in neglected and abandoned corn and sugar cane fields. When undisturbed it grows thickly, and during flowering season, the pale white erect spikes make a beautiful show. If the weed is allowed to grow and multiply, due to its profuse number of seeds, eventually the time will come when the plant will be almost impossible to eradicate. This is one of the plants introduced in the early days as an ornamental, but its neglect has made it a terrible weed. It is quite easy to control. Killing the plant by cutting at the base of the stem, before flowering is very effective means. Its only methods of reproduction is by seeds. The seeds very often go with rice as an impurity, especially upland rice. It is spontaneous. Its origin is doubtful, but apparently it is American. It flowers from August to February.

Field No. 1617.

AMARANTHUS SPINOSUS Linn. (Plate XXVIII, fig. 23.)

Local names: Akum (Mag.); báoan (Bon.); bayambáng (Tag.); gitingíting (Sul.); kalúnai (Ilk.); kulítis (P. Bis.); kuantúng (Ilk.); oori (Tag.); cort (Tag.); orái (Tag.); siitan ñga siitan (Ilk.); urái (Tag.) English names: Spiny Amaranth; prickly careless weed; soldier weed.

A stout, erect, glabrous, branched, annual herb, armed with slender axillary spines. Flowers small, green or greenish white. It is distinguished from *A. viridis,* and other species by the presence of the spines at the junction of the leaves with the stem. Seeds very small, much smaller than the seeds of *A. viridis,* smooth, dark, shining brown, orbicular, with a slight notch at the narrow end, double convex 0.6–0.8 mm., in diameter.

It is very common and widely distributed throughout the Philippines at low altitudes in the settled areas, and in open waste places. It is gregarious and abundant also along gravel and sand bars in the beds of streams. The plant, succulent as it is, is sometimes eaten by the natives as "gulay." It is also fed to hogs. Aside from such very meager use of the plant it is one of the worst of weeds. Its pestiferous effect is due to its free growth and the presence of the prickly annoying spines, and also due to ability of the seeds to stand any sort of difficult conditions such as drying and also excessive moisture during rainy season. The best control is to prevent seed production by cutting the plant. It flowers all the year. The only method of reproduction is by seed. Accidentally introduced. Spontaneous. It is a native of Tropical America. Pantropic in distribution.

Field No. 1682.

AMARANTHUS VIRIDIS Linn. (Plate XXVIII, fig. 24.)

Euxolus caudatus Naves.

Euxolus viridia Miq.

Local names: Báuan (Bon.); kadiapa (Mbo.); kalúnai (Ilk.); kolítes (Tag.); siitan (Ilk.).

An erect glabrous, branched, unarmed, annual herb. Flowers very small, green. Seeds dark-brown to jet-black, broadly ovate, with a little notch at the narrow end, smooth, highly polished, 1.0–1.3 mm. long, 0.8–1.2 mm. wide.

A common weed throughout the Philippines at low and medium altitudes. Habitat, like *A. spinosus.* It flowers all the year. It is probably introduced. Spontaneous. Origin is doubtful. Found in all warm countries.

Field No. 1622.

ACHYRANTHES ASPERA (Linn.) (Plate XXVIII, fig. 25.)

Desmochaeta repens Llanos.

Local names: Angud (Pamp.); deket-déket (Ilk.); garém (Ilk.); guéla (Neg.); hañgód, hañgór (Tag.); higad-higad (Ilk.); rag-ragádi (Ilk.).

A coarse annual herb with spikes, which are rigid, elongated. Flowers green. Seeds light brown, oblong, remains of a beak persistent, base rather tapering, surface with longitudinal depressions, slightly roughened, slightly tomentose, more or less circular in cross section, 3.1–3.5 mm. long, 0.8–1.2 mm. wide.

It is a common weed in the settled areas throughout the Philippines. It is also abundant at low and medium altitudes, in open waste places. The utricle is responsible for the successful dissemination of the seeds. The utricles cling to

moving objects by means of the spines, which are found at the base. These utricles are oblong or ovoid, asperous, and indehiscent. The spines at the base of the utricle are hooked and sharp. It flowers all the year. Accidentally introduced. Spontaneous. Pantropic.

Field No. 1646.

PORTULACACEAE

PORTULACA OLERACEA Linn. (Plate XXVIII, fig. 26.)

Local names: Alusiman (Bik.); golasíman (Tag.); ñgalug (Ilk.); kantatába (Pang.); makablíng (Tag.); ulisiman (Tag.); sahíkan (Bik., Tag.); olisíman (Tag.); English names: purslane, pursley, wild Portulaca, duckweed. De Candolle in the "The Origin of Cultivated Plants," quotes the names of *Lovico* (Sanskrit); *Andrachne* (Greek); and *Portulaca* (Latin).

An annual succulent herb, very well known to farmers and gardeners. It commonly grows in prostrate mats, spreading and branched. The thick watery stem is made up mostly of water. Flowers small, yellow. Capsules open by a transverse cleft at about the middle. Seeds reddish brown, mostly shining jet-black, sometimes with purplish tinge, broadly oval or almost circular, often having a curved tooth or point on one side, flattened, hilum prominent, whitish, surface covered with 3–4 curved rows of minute tubercles, extending to the hilum in concentric rows, 0.5–0.8 mm. in diameter. A very common weed throughout the Philippines. Cultivated as a pot herb in the early days, and still so used. The seed commonly occur in commercial garden seeds. It is sometimes used by man as food. Hogs are fond of it. Due to its mode of reproduction the plant has become a terrible weed to control, first because of the enormous number of seeds produced and secondly because of its peculiar habit of reproducing vegetatively. Its persistency is also due to the vitality of the seeds. Beal(2) has shown that the seeds will germinate after having lain dormant in the soil for 30 years. The best control is to kill it while in seedling stage. The common practice of farmers of leaving the cut or hoed stems lying in the fields is an encouragement for the plant to multiply, and this should be abandoned. All hoed or cut stems should be removed from the fields and burned or fed to hogs. De Candolle believes that the plant is indigenous in the whole region which extends from the western Himalayas to the South of Russia and Greece. It is, however, found now in all warm countries. Its origin remains doubtful.

Field No. 1658.

CAPPARIDACEAE

GYNANDROPSIS GYNANDRA Linn. (Plate XXVIII, fig. 27.)

Cleome gynandra Linn.
Cleome pentaphylla Linn.
Gynandropsis pentaphylla DC.
Pedicellaria pentaphylla Schrank.
Sinapistrum pentaphyllum Medic.
Cleome alliacea Blanco.
Cleome alliodora Blanco.

Local names: Apoi-apoian (Tag.); halaya (P. Bis.); tantandók-a-dakél (Ilk.).

An erect, annual, somewhat pubescent herb. Flowers white. Capsules cylindric, 4–12 cm. long. Seeds numerous in linear capsules, dark-brown, with purplish tinge, reniform, hilum quite conspicuous, surface covered with fine rugose reticulations, arranged in spider-web fashion pits prominent, not iso-diametric 1.2–1.5 mm. diameter.

A quite common weed throughout the Philippines at low and medium altitudes, in waste places; often abundant near the sea. It occurs also in profuse abundance in abandoned upland rice fields. As the root system of the plant is not so deep mere pulling off of the plant will suffice for its removal from the field. However, it has never been very troublesome weed. It flowers all the year. Accidentally introduced. Spontaneous. Its origin is unknown. Pantropic in distribution.

Field No. 1501.

OENOTHERACEAE

JUSSIAEA LINIFOLIA Linn. (Plate XXVIII, fig. 28.)

Jussiaea acuminata Sw.
Jussiaea costata Presl.

Local names: Baringana (Bik.); mana-katud (Ilk.); pasao hapay, silasila (Tag.); taklang duron (Pamp.); tohod tohod (Bik.).

An erect, annual, branched, glabrous herb. Flowers yellow. Seeds light orange, ellipsoid, surface smooth, faintly covered with very minute tubercles, one side with a prominent ridge which runs from end to end of the seed, 0.9–1.1 mm. long, 0.4–0.5 mm. wide.

Distributed from northern Luzon to Palawan and Mindanao. In open damp or wet places along streams, in rice paddies, etc., at low and medium altitudes in most or all islands and provinces. It is more or less aquatic in habit, but is able to thrive too under xerophytic conditions. The seeds being very minute are transported by adhering in mud to the feet of animals, or

feet or feathers of migratory birds. It is a very common weed, but not a pernicious one. Accidentally introduced. Spontaenous in occurrence. It is a native of tropical America, and became naturalized in the Philippines. Pantropic in distribution.

Field No. 1720.

PAPAVERACEAE

ARGEMONE MEXICANA Linn. (Plate XXVIII, fig. 29.)

Local names: Baruás (Iv.); diluáriu (Tag.); kachúmba (Ilk.); kagang-kágang (C. Bis.); diliwarine (Tag.). English names: Mexican poppy, thistle poppy, devils fig.

Erect, rather stout, branched, annual herb, 1 meter high or less, with yellow sap. Flowers yellow, terminal, 4–5 cm. in diameter. Capsule spiny, about 3 cm. long. It is seldom a biennial. Seeds grayish brown, crested on one side, rounded oval, with a central sharp ridge running to the apex (raphe). sides rounded, whole surface coarsely netted, marked with angular pits arranged in rows, 1.2–1.8 mm. in diameter.

This is the only species of Papaveraceae found in the Philippines. It is a very common weed in an about towns, in waste places and along railroad embankments in Batangas Province. This is one which was purposely introduced as a medicinal plant, but now has become a weed. The time of introduction is uncertain. The plant is not mentioned by Mercado nor by Camell. It was however, described by Blanco in the year 1837. It is still extensively used by the natives in the practice of medicine, especially by the herb doctors. The yellow juice which is considered poisonous is used by the natives to heal "fissures of the corners of the eyes." Tavera(39) states that the yellowish oil of the seeds is laxative and is supposed to relieve the pain in cholera. It is a drying oil and may have a good use for paint manufacture in the future. Bacon(1) enumerates various uses of the plant. The plant flowers most of the year. Pulling out the plants before flowering is suggested as the best method of control. It is a native of Mexico, and now Pantropic in distribution.

Field No. 1618.

LEGUMINOSAE

MIMOSA PUDICA Linn. (Plate XXVIII, fig. 30.)

Mimosa asperata Blanco.

Local names: Damohia (Tag.); dilgansúsu (Ilk.); harupai (S. L. Bis.); kirómkiróm (S. L. Bis.); makahia (Pang., Tag.); tuyag-huyag (P. Bis.).

A low prostrate, prickly, diffusely spreading herb. Leaflets very sensitive; heads globose, numerous; flowers pink. Seeds

yellowish brown to brown, oval to nearly circular, surface quite smooth, not shining, flattened, double-convex near the periphery of both surfaces a dark line goes around and terminates near the apex, hilum short at the apical end, cross section ellipsoid, 2.6–3.0 mm. in diameter.

In the 17th century it was known in the Philippines only by the Spanish name *Hierba mimosa.* It is today one of the most common and most troublesome weeds throughout the Philippines. It is abundant and widely distributed in open waste places at low and medium altitudes in the settled areas. The nativity of the plant is not well known but it is probably from Brazil. Doubtless introduced here from Mexico. Spontaneous. It flowers all the year, and the only mode of reproduction is by seeds. It is pantropic in distribution.

Field No. 1733.

CASSIA OCCIDENTALIS Linn. (Plate XXIX, fig. 31.)

Local names: Andadasí (Ilk.); duda (C. Bis.); kabalkabalan (Tag.); katañgan-áso (Tag.); sumting (S. L. Bis.); tambalisa (Tag.). Other names: Coffee Serma, Negro coffee, Magdad coffee.

An annual shrub. Flowers yellow. Seeds light brown to brown, oval, flat, smooth, testa covered near the margin with chartaceous hyaline membrane, breaks on surface give the cross marks on margins. In the fresh specimen the membrane is adnate, but in dried ones the membrane flakes off. The central portion of each face of the seed is not covered with membrane, but minutely laterally striated 2.5–3.8 mm. in diameter.

Found throughout the Philippines at low and medium altitudes. A common weed in waste places in and about towns. Due to its shrubby habit of overgrowing other crop plants, the plant is a troublesome weed. It is known to the natives as poisonous to animals, as the seeds act as strong cathartic. It flowers all the year, and propagates by seeds. Accidentally introduced. Spontaneous. It is a native of tropical America, now pantropic.

Field No. 1648.

CASSIA TORA Linn. (Plate XXIX, fig. 32.)

Cassia obtusifolia Linn.

Local names: Andadási (Ilk.); andadási-ñga-dadakkel (Ilk.); balátong-áso (Pang., Tag.); katandang-áso (Tag.); mongo-mongohan (Tag.).

An annual. Flowers yellow. Seeds reddish brown, rhomboidal, smooth, with scattered very shallow pits, some sides concave, 4.5–5.0 mm. long, 2.6–3.0 mm. wide.

Widely distributed in the Philippines, and exceedingly abundant in the settled areas at low and medium altitudes and in

about towns, and settlements. Its habit is like *Cassia occidentalis* Linn. Flowers all the year. Propagates by seeds. Accidentally introduced. Spontaneous. It is a native of tropical America, now pantropic in distribution.

Field No. 1614.

DESMODIUM TRIFLORUM (Linn.) DC. (Plate XXIX, fig. 33.)

Hedysarum triflorum Linn.
Hippocrepis humilis Blanco.
Desmodium parvifolium Blanco.
Meibomia triflora O. Kuntze.

Local name: Pakpák-láñgau (Tag.).

A slender, prostrate, branched, somewhat hairy herb. Perennial. Seeds reddish brown, reniform or oblong, ends either repand or truncate, flattened, hilum very small, quite prominent, surface smooth dull or somewhat glossy, 2.2–2.5 mm. long, 1.5–1.8 mm. wide.

Found in open grassy places and lawns especially in and about towns throughout the Philippines. It is very prominent weed in lawns. Due to its creeping habit, it is quite difficult to exterminate, but constant hoeing will control it. It, however, may serve as a soil binder. It flowers most of the year, but very profuse flowering has been observed during the months of April to June, and November. Accidentally introduced. Spontaneous. Its nativity is unknown. Pantropic in distribution.

Field No. 1677.

ALYSICARPUS NUMMULARIFOLIUS (Linn.) DC. (Plate XXIX, fig. 34.)

Hedysarum nummularifolium Linn.
Alysicarpus vaginalis DC. var. nummularifolium Miq.
Fabricia nummularifolia O. Kuntze.

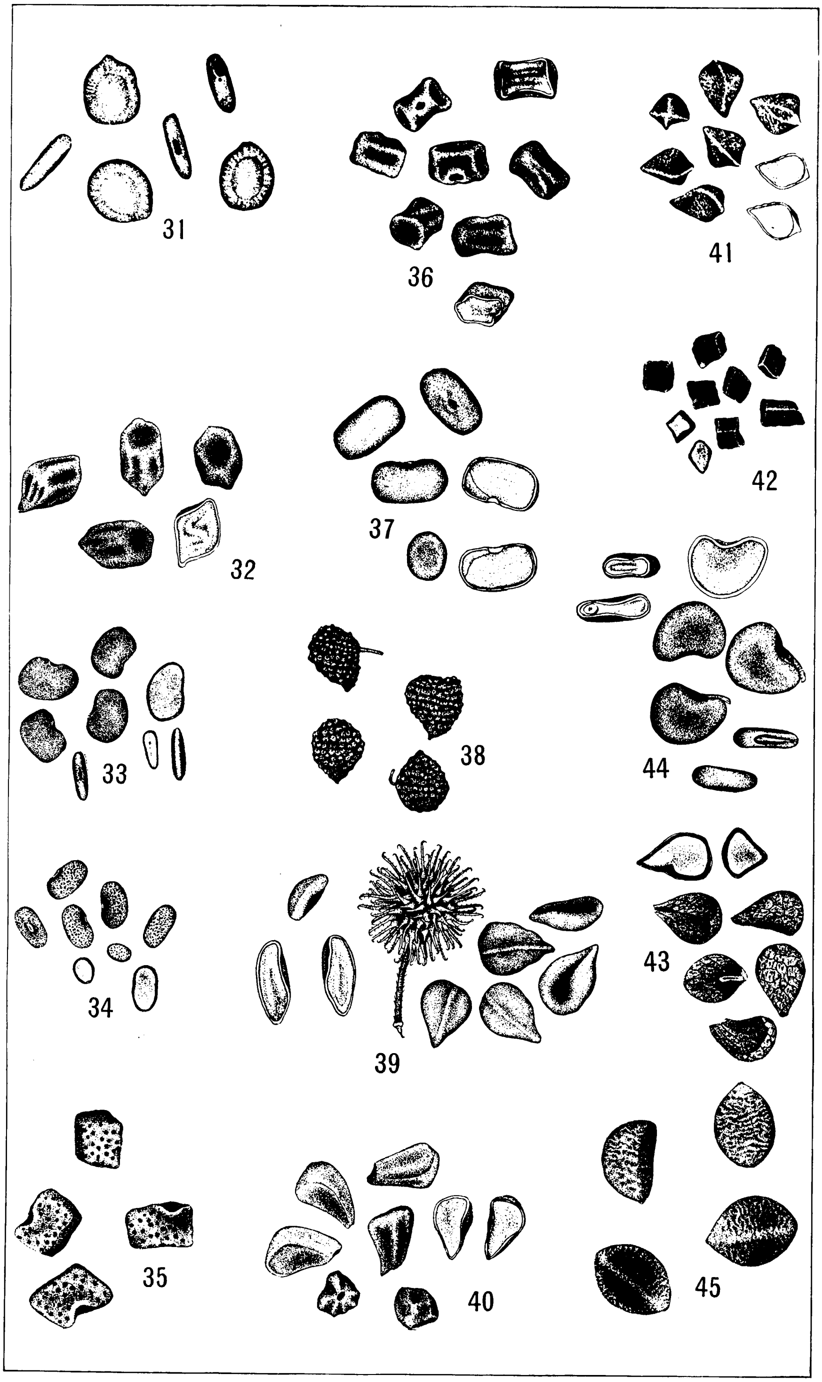
Local names: Baníg-usá (Tag.); mani-manían (Tag.); maní-maní (P. Bis.); maramaní (Ilk.).

An annual, spreading or prostrate branched herb. Flowers pink-purple. Seeds light yellow, mottled all over the surface with purplish or brownish dots, oblong to very slightly reniform, both ends obtuse, surface smooth, shining, raphe prominent, funiculus still persistent, cross section oval, 1.8–2.2 mm. long, 1.0–1.2 mm. wide.

Widely distributed in the Philippines at low and medium altitudes, in open grass lands; variable. A very common weed of the lawns, and propagates by means of the seeds. It flowers more or less all the year. Accidentally introduced. Sponta-

PLATE XXIX

FIG. 31. Seeds of *Cassia occidentalis* Linn. × 2.5.
32. Seeds of *Cassia tora* Linn. × 2.5
33. Seeds of *Desmodium triflorum* (Linn.) DC. × 5.
34. Seeds of *Alysicarpus nummularifolius* (Linn.) DC. × 4.
35. Seeds of *Indigofera hirsuta* Linn. × 5.
36. Seeds of *Indigofera suffruticosa* Mill. × 5.
37. Seeds of *Sesbania cannabina* (Retz.) Pers. × 4.
38. Seeds of *Biophytum sensitivum* (Linn.) DC. × 10.
39. Fruit (×2) and Seeds (×5) of *Triumfetta semitriloba* Jacq.
40. Seeds of *Corchorus capsularis* Linn. × 5.
41. Seeds of *Corchorus olitorius* Linn. × 5.
42. Seeds of *Corchorus acutangulus* Lam. × 5.
43. Seeds of *Malachra capitata* Linn. × 5.
44. Seeds of *Abutilon indicum* (Linn.) Sweet. × 5.
45. Seeds of *Melochia concatenata* Linn. ×5.


31
36
41
42
32
37
33
38
44
34
39
43
35
40
45

neous. Origin, European or Oriental. Distributed in the tropics of the Old World, and introduced in tropical America.

Field No. 1620.

INDIGOFERA HIRSUTA Linn. (Plate XXIX, fig. 35.)

Indigofera angustifolia Blanco.
Indigofera tinctoria Naves.

Local names: Taíuman (Tag.); taium-taiúman (Tag.).

An erect, branched, suffrutescent, annual herb. Flowers reddish-purple. Seeds reddish brown or dark brown, rhomboidal, nearly rectangular, 6 faced surface slightly rugose, irregularly and deeply pitted, sometimes concave, hilum at the middle of one of the angles, 1.2–1.5 mm. long, 1.0–1.2 mm. wide.

Distributed from Northern Luzon to Mindanao. In waste places in and about towns. It is rarely cultivated here for indigo. It flowers most of the year. It is reproduced by seeds only, and its distribution is attributed to the explosive character of the straight reflexed pods. The seeds are scattered only in a limited area, but the manner of distribution makes the second year of growth very heavy. Accidentally introduced. Spontaneous. Origin, Oriental or European. Pantropic in distribution.

Field No. 1607.

INDIGOFERA SUFFRUTICOSA Mill. (Plate XXIX, fig. 36.)

Indigofera anil Linn.
Indigofera argentea Blanco.

Local names: Páuai (Iv.); tágum (S. L. Bis.); Tágun (P. Bis.); táyom (Ilk.); táyon (Ilk.); táyum (Ilk., Tag., P. Bis., C. Bis.); tina-tináan (Tag.); yagum (Bis.).

An erect, branched, suffrutescent herb. Flowers red. Pods curved. Seeds brown, same shape as *I. hirsuta,* whole surface not pitted as in *I. hirsuta* rather rugose, deeply depressed faces, hilum very prominently fixed in the middle of one angle, smaller than *I. hirsuta* 1.4–1.9 mm. long, 0.8–1.2 mm. wide.

Batan Islands and Northern Luzon to Mindanao. In waste places in and about towns, locally abundant; occasionally cultivated for its indigo. This weed may be developed in the future as a cover crop and also as a source of indigo. It is reproduced by seeds only. It flowers most of the year. Accidentally introduced. Spontaneous. It is a native of tropical America. Pantropic in distribution.

Field No. 1683.

SESBANIA CANNABINA (Retz.) Pers. (Plate XXIX, fig. 37.)

Aeschynomene cannabina Retz.
Agati cannabina Desv.
Sesbania aegyptiaca F.-Vill.
Sesbania aculeata F.-Vill.
Sesbania picta Vidal.

Local names: Balakbák (Tag.); bayakbák-bukit (Pamp.) ganai (C. Bis.); rubáu (Ilk.); tabing (Mag.).

An erect, branched, suffrutescent, annual herb. Flowers yellow. Seeds brown to black, lighter at both ends, shape, as *Alysicarpus nummularifolius*, surface generally smooth with short and irregular striations running on the faces, hilum quite prominent, 3.0–3.5 mm. long, 1.8–2.0 mm. wide.

Northern Luzon to Mindanao. Very common along streams in open wet lands, etc., at low and medium altitudes. The roots of the plant are seldom deep-rooted so shallow plowing is enough to uproot the plants, and control the vast increase especially fallow sugar cane lands. It flowers more or less throughout the year. It is reproduced by seeds. Accidentally introduced. Spontaneous. Origin unknown. Distributed from India to Malaya.

Field No. 1653.

OXALIDACEAE

BIOPHYTUM SENSITIVUM (Linn.) DC. (Plate XXIX, fig. 38.)

Oxalis sensitiva Linn.
Oxalis cumingiana Turcs.
Oxalis reinwardtii F.-Vill.

Local names: Damong-bingkálat (Tag.); hoya-hoya (P. Bis.); makahiáng-laláki (Tag.).

An erect, small, unbranched, annual herb. Leaves crowded at the top of the stem. Flowers yellow, small. Capsules ovoid to oblong, loculicidal dehiscent. Seeds light reddish brown, ovoid or globose, hilum inconspicuous, funiculus very often persistent, surface irregularly tuberculate, tubercles forming rows of ridges, 0.6–0.8 mm. long, 0.4–0.6 mm. wide.

Northern Luzon to Mindanao and Sulu. In grasslands, open thickets, and abandoned rice fields, etc., at low and medium altitudes. It is not a pestiferous weed, and can be exterminated easily by pulling the whole plant. It flowers from August to October, and probably in other months. It is propagated by seeds. Accidentally introduced. Spontaneous. Origin, Oriental or European. Now pantropic in distribution.

Field No. 1492.

TILIACEAE

TRIUMFETTA SEMITRILOBA Jacq. (Plate XXIX, fig. 39.)

Local names: Kulutan (Tag.); kulutkulut (Ilk.); kuput (Ig.).

An erect branched, suffrutescent shrubby plant. Flowers yellow. Fruits globose, pubescent, covered with hooked spines, the spines scattered, reflexed hairs. Perennial. Seeds brown, ovate apex tapering, acute, base truncate, surface somewhat smooth, with very minute pits, dorsad convex, ridged at the middle, running from base to apex, ventrad grooved somewhat, hilum on dorsal surface, 2.3–3.0 mm. long, 1.8–2.1 mm. wide.

Widely distributed in the Philippines in dry thickets at low and medium altitudes. Quite common in abandoned fields. Plants growing in dense thickets are long and slender and bast fibres from the stem may be used to advantage for sac manufacture. The seeds are scattered with the capsules. The effective dissemination of the seeds is due to the hooked capsules, which can easily cling on man's clothes or animals' skin or hair. It flowers from December to February. Undoubtedly introduced, but possibly accidental. Spontaneous. Origin, American. Pantropic in distribution.

Field No. 1679.

CORCHORUS CAPSULARIS Linn. (Plate XXIX, fig. 40.)

Local names: Panigbin (S. L. Bis.); saluyut (Ilk.); sumpa (S. L. Bis.).

An erect branched, glabrous, annual herb. Flowers yellow. Capsules globose, to globose-ovoid, longitudinally ridged, prominently rugose, muricate, 5-angled. Seeds brown, variously shaped, lanceolate, slightly curved, somewhat flattened, surfaces irregular, some flat, others convex and concave, slightly striated, minutely tuberculate, angles nearly smooth, rather sharp, hilum small, at smaller end apex slightly tapering and rounded 2.0–2.4 mm. long, 1.1–1.6 mm. wide.

In clearings, on rice paddies, and banks of rice paddies, and in open, low, usually wet places in and near settlements throughout the Philippines, but not planted. Stems yield bast fibres, used in the manufacture of sacks. It is extensively cultivated in some tropical countries for the fibre called jute, but also occurs wild in these countries. Purposely introduced, cultivated. Spontaneous. It is a native of India, and now is pantropic. It flowers from October to January.

Field No. 1678.

CORCHORUS OLITORIUS Linn. (Plate XXIX, fig. 41.)

Corchorus catharticus Blanco.

Local names: Pasao (Tag., Sbl.); saluyut (Ilk.); tagabang (Bis.); yaka (Mag.); Jute.

An erect, branched, glabrous or nearly glabrous, suffrutescent annual. Flowers yellow. Capsules elongated, elliptic, 10-ribed, 3- or 6-valved, valves with transverse partitions between the seeds. Seeds black, ovoid, surface rugose, with irregular tuberculate ridges, convex, with ellipsoid ridge on top, ventrad generally grooved, hilum occupying almost half dorsal surface, 1.8–2.0 mm. long, 1.3–1.4 mm. wide.

In and near settlements, on rice paddy banks, fallow fields, etc., throughout the Philippines. It has the same use as *C. capsularis*. As a weed it is not hard to control and exterminate. It flowers from October to January. Purposely introduced. Spontaneous. It is a native of India. Pantropic in distribution.

Field No. 1712.

CORCHORUS ACUTANGULUS Lam. (Plate XXIX, fig. 42.)

Corchorus aestuans Blanco.

Local names: Sal-saluyut (Ilk.); saluyot (Ilk., Tag.).

A low diffusely branched, suffrutescent annual. Flowers yellow. Capsule narrowly oblong, prominently longitudinally 6- to 8-ridged or winged. Seeds dark brown, or black, rhomboidal, surface minutely pitted, almost smooth, angles and faces very prominent, hilum at the corner of the basal square side, smaller than the preceding species, 1.0–1.2 mm. long, 0.6–1.0 mm. wide.

In open waste places at low and medium altitudes, throughout the Philippines, certainly an accidentally introduced weed. It flowers from August to January. Spontaneous. It is pantropic in distribution, but probably a native of tropical Asia. In all cases all the species of *Corchorus* are reproduced by seeds, and the per cent of germination in them is high.

Field No. 1664.

MALVACEAE

MALACHRA CAPITATA Linn. (Plate XXIX, fig. 43.)

Napaea latifolia Blanco.

Local names: Paang-balíuis (Tag.).

An erect, coarse, annual hairy herb. Flowers yellow. Seeds sayal brown, marked with angular dark lines, ovate, apex rounded, base tapering with a slit, surface hirsute, hairs very short, not smooth, 3-faced, 2 being flat, the third one, convex, 2.8–3.0 mm. long, 1.8–2.0 mm. wide.

Luzon (Union, Nueva Ecija, Pampanga, Rizal, Cavite, Manila, Laguna). A common weed in open waste places. If attention is given to this plant, it may be cultivated to advantage, as the stem yields fine and strong bast fibres which may be used for the manufacture of sacks. It will eventually become a troublesome weed if allowed to multiply. It flowers from September to February. It is reproduced by seeds. Accidentally introduced. Spontaneous. Origin tropical America. Pantropic in distribution.

Field No. 1709.

ABUTILON INDICUM (Linn.) Sweet. (Plate XXIX, fig. 44.)

Sida indica Linn.

Local names: Giling-giliñgan (Tag.); málbas (Tag., Mbo.); malva, or malvas (Sp.); márbas (Tag.); sup-luppaao (Ilk.).

An erect, suffrutescent, undershrub. Annual or perennial. Flowers yellow. Seeds blackish brown, somewhat reniform to ovoid, surface somewhat asperous, covered all over with minute granular tubercles, flattened, both faces with depression at center, sides rounded, 2.2–2.8 mm. long, 2.2–2.5 mm. wide.

This species is common and widely distributed throughout the Philippines in thickets and waste places in and about towns at low and medium altitudes. It is not a troublesome weed. The plant has quite long tap root, but when a seedling it pulls out easily. It is certainly an introduced weed in the Archipelago, and was introduced originally as a medicinal plant. It is spontaneous or partly cultivated for medicinal purposes. The leaves are boiled in water, and the liquid is used as an enema for babies, and for washing ulcers. It flowers all the year. Origin, Oriental or European. It is pantropic in distribution.

Field No. 1719.

STERCULIACEAE

MELOCHIA CONCATENATA Linn. (Plate XXIX, fig. 45.)

Melochia supina Linn.
Melochia corchorifolia Linn.
Riedelia corchorifolia DC.
Geruma subtriloba Blanco.

Local names: Bankalánan (Ilk.); kaliñgan (P. Bis.).

An erect or spreading, branched, suffrutescent herb, with scattered stellate hairs or nearly glabrous. Flowers white, pink or pale-purple. Capsules depressed-globose, slightly hirsute. Seeds blackish brown, obovoid, faintly rugose, with striations of brown wavy ridges, slightly pitted, 3-faced, 2 being flat, the third rounded and convex, ridged opposite convex surface very

prominent, hilum at one end, 2.0–2.2 mm. long, 1.2–1.8 mm. wide.

Throughout the Philippines at low and medium altitudes in the settled areas, a weed in waste places, in open grasslands, fallow fields, etc. It flowers all the year. Accidentally introduced. Spontaneous. Its nativity is unknown. Pantropic.

Field No. 1502.

LABIATAE

HYPTIS SUAVEOLENS (L.) Poir. (Plate XXX, fig. 46.)

Marrubium indicum Blanco.

Local names: Bangbangsit (Ilk.); kablíng-kabáyo (Tag.); litalit (Ilk.); pansipansían (Tag.); pilodo (P. Bis.); suag-kabáyo, suob-kabáyo (Tag.).

A coarse, erect, branched, more or less hairy aromatic herb. Flowers blue. Nutlets seal brown, cuneate, base acuminate, hilum white, very prominent at the basal end, apex truncate, flattened, whole surface irregularly pitted, one face depressed, the other with very sharp ridge at the middle extending from the base to the apex, becoming mucilagenous when soaked in water, 3.5–3.8 mm. long, 2.2–2.6 mm. wide.

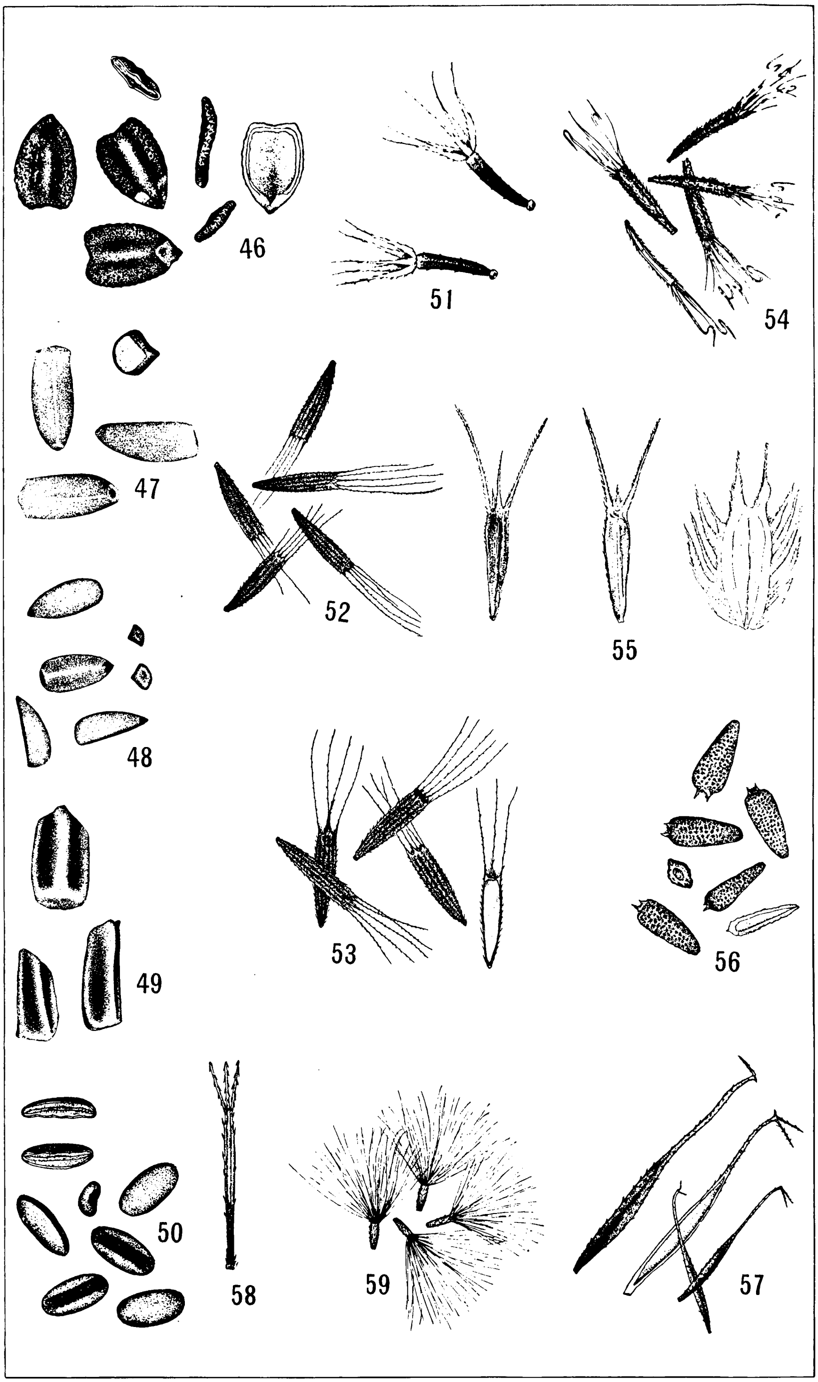
Throughout the Philippines. Very abundant weed in open waste places at low and medium altitudes. The plant is much used by the natives to get rid of bed bugs. This is simply done by cutting off branches, preferably leaves of this plant, and these are placed under the bed. The bed bugs are not killed by such application, but they are driven away. The leaves are likewise used by the farmers to get rid of lice in hens' nests. The leaves and stem possess such a strong aromatic odor that one can smell it a considerable distance. This plant is, however, a persistent weed, and may be scattered from place to place by means of its seeds. The seeds are coated with a mucilagenous substance such that when wetted with the dew of the morning or water of the rain the mucilage substance (Doctor Eckerson, formerly of the Department of Botany, University of Chicago calls it a pectic substance), swells up, and has a gummy texture. The wet seeds easily attach themselves to clothes or to coats of the animals and are dropped off when they become dried. The seeds germinate very quickly when the ground is wet. The plant flowers all the year, and that makes it more difficult to eradicate if allowed to multiply, as the plant possesses a well developed root system, with strong tap root, and quite strong secondary roots. Plowing the field before the plants flower is best. It is one of those weeds accidentally introduced in the packing material. Spontaneous. It is a native of tropical America, and pantropic in distribution.

Field No. 1715.

199818——8

PLATE XXX

FIG. 46. Seeds of *Hyptis suaveolens* (L.) Poir. × 5.
47. Seeds of *Leucas aspera* (Willd.) Spreng. × 7.
48. Seeds of *Leucas lavandulifolia* Sm. × 5.
49. Seeds of *Leucas javanica* Benth. × 10.
50. Seeds of *Borreria hispida* (Linn.) K. Schum. × 5.
51. Achenes of *Ageratum conyzoides* Linn. × 5.
52. Achenes of *Elephantopus mollis* HBK. × 5.
53. Achenes of *Elephantopus scaber* Linn. × 5.
54. Achenes of *Elephantopus spicatus* Aubl. × 5.
55. Achenes of *Synedrella nodiflora* (Linn.) Gaertn. × 5.
56. Achenes of *Eclipta alba* (Linn.) Hassk. × 5.
57. Achenes of *Cosmos caudatus* HBK. × 1.33.
58. Achenes of *Bidens leucorrhiza* (Lour.) DC. × 1.33.
59. Achenes of *Blumea balsamifera* (Linn.) DC. × 5.


46
51
54
47
52
55
48
49
53
56
50
58
59
57

LEUCAS ASPERA (Willd.) Spreng. (Plate XXX, fig. 47.)

Phlomis aspera Willd.

Local names: Pansi-pánsi (Ting.); sipsipan (Pamp.).

An annual herb. Nutlets cinnamon-brown, oblong-lanceolate, triquetrous, 2-edges flat, third one convex, surface smooth, somewhat shining, hilum prominent, base more or less papillate, 2.0–2.1 mm. long, 0.7–0.8 mm. wide.

Luzon (Cagayan, Isabela, Ilocos Norte, Abra, Union, Pampanga, Bataan), Mindoro, Mindanao (Lanao). A very common weed in the open dry sandy soil in waste places, locally abundant. It was certainly accidentally introduced. Spontaneous. Origin, unknown. Found in India to Mauritius and Java.

Field No. 1610.

LEUCAS LAVANDULIFOLIA Sm. (Plate XXX, fig. 48.)

Leucas linifolia Spreng.
Phlomis zeylanica Blanco.

Local names: Kaskasúmba (Ilk.); lañga-lañga (Bik.); pansi-pánsi (Tag.); salita (Tag.).

An erect, branched herb. Flowers white. Nutlets clay color to blackish brown, form almost like *L. aspera*, triquetrous, apex tapering, not papillate, surface smooth, 2.1–2.6 mm. long, 0.8–1.1 mm. wide.

Luzon (Cagayan to Sorsogon), Polillo, Mindoro, Mindanao (Surigao). A common weed in open waste places at low and medium altitudes. Flowers all the year. Certainly it was accidentally introduced. It is distributed from India to southern China, the Mascarene Islands, and Malaya. Origin is rather doubtful.

Field No. 1608.

LEUCAS JAVANICA Benth. (Plate XXX, fig. 49.)

Local names: Bangansit (Ilk.); paling-haráp (Tag.).

An erect, or ascending branched, pubescent herb. Flowers white. Nutlets chesnut brown, irregular in outline, oblong-elongate, surface smooth, more or less flattened, not triquetrous, dorsal surface with a ridge at the middle, base blunt, smallest of the three species considered here, 1.0–1.4 mm. long, 0.5–0.8 mm. wide.

Batan Islands, Luzon (Ilocos Norte, Rizal, Bataan, Laguna, Tayabas, Batangas), Mindoro, Palawan, Mindanao (Agusan, Zamboanga). A quite common weed in thickets, old clearings, about walls, etc., at low and medium altitudes. Flowers from

September to January. Accidentally introduced? Spontaneous. Origin, unknown. Formosa, Java.

Field No. 1611.

RUBIACEAE

BORRERIA HISPIDA (Linn.) K. Schum. (Plate XXX, fig. 50.)

Spermacoce hispida Linn.
Borreria discolor Bartl.
Spermacoce mutilata Blanco.
Spermacoce muriculata Blanco.
Spermacoce scaberrima F.-Vill.

Local names: Landrina (Tag.).

A procumbent, branched, scabrid or hispid herb. Flowers pale-blue or nearly white. Capsules oblong-ovoid, hispid or hirsute, of 2 crustaceous or coriaceous mericarps which dehisce variously. Seeds warm blackish brown, oblong, surface thickly covered with minute tubercles, shining, shaped like a shallow thick-walled canoe, with ends rounded alike, hilum occupies the middle of the narrow concave side, other side convex, allantoid in cross section, 2.8–3.0 mm. long, 1.0–1.5 mm. wide.

Batan Islands and Luzon (Cagayan to Batangas and Laguna), Mindoro, Panay, Basilan. In open dry places at low and medium altitudes. A very common weed in lawns. Flowers from July to February. Accidentally introduced. Spontaneous. Origin, unknown.

Field No. 1714.

COMPOSITAE

AGERATUM CONYZOIDES Linn. (Plate XXX, fig. 51.)

Local names: Asipiukpuk (Pang.); bahug-bahug (P. Bis.); damong pallas (Tag.); kamubuag (Iv.); kulong-kogong bábaya (Bik.); kologong-kabayo (Tag.); pagpagay (Bon.); singilan (Ilk.).

An annual, erect, branched, somewhat aromatic, pubescent herb, 1 to 2 feet high, with numerous small heads of white or pale-blue flowers in dense terminal corymbs. Achenes black, 5-angled, angles spinous, arranged upward, awned, awns often serrate below, awns spreading, as long as the seed, hilum more or less globular, white, 1.6–2.5 mm. long, 0.3–0.5 mm. wide without the awns.

A very common weed in open waste places throughout the Philippines, from sea level to an altitude of 2,000 meters. In the mountains it is especially abundant along shaded trails in regions where the rainfall is abundant. So far as known this has no uses. As a weed, it is quite troublesome in fallowed lands. It is scattered by man and animals by means of its barbed awns and seeds, which easily attach to the clothes of

man, or to the coats of animals. It flowers all the year. This species is undoubtedly from Mexico, but it is found at present throughout the tropics of the world. One of those accidentally introduced, and spontaneous in habit.

Field No. 1609.

ELEPHANTOPUS MOLLIS HBK. (Plate XXX, fig. 52.)

Elephantopus serratus Blanco.

Local names: Kaburon (Ig.); tab-tabáko (Ilk.); tigalang (Sul.).

A tall erect, more or less hirsute herb. Clusters of heads terminating the branches. Flowers white. Achenes of cinnamon color, linear, base tapering, ribbed, pubescent all over the ribs, hairs running upward, awns 4–5, straight, barbed upward, bristles rigid, base of pappus swollen, 2.8–3.2 mm. long, 0.6–0.8 mm. wide without awns.

Accidentally introduced into the Philippines, but now thoroughly naturalized, and spontaneous. It is common throughout the Philippines, in open waste places and grasslands, from sea level to an altitude of 2,000 meters. It is quite often found along the roads, and the pubescent and spiny condition of the awns makes it easy for the seeds to spread to a considerable distance by clinging to moving objects. It is not a troublesome weed in cultivated fields. It flowers from December to April. It is a native of Mexico, now also in the Marianne and Caroline Islands, Formosa, and Borneo.

Field No. 1702.

ELEPHANTOPUS SCABER Linn. (Plate XXX, fig. 53.)

Local names: Dila-dila (Tag.); kabkabron (Ilk.); taba-tabacohan (Tag.).

A rather coarse, rigid herb. Heads in clusters at the ends of the branches. Achenes of the same color as *E. mollis*, pubescent, ribbed, form same as *E. mollis*, awns 5–6, straight, hyaline, longer than the seed body; 3.5–4.0 mm. long, without awns.

Luzon (Union, Bulacan, Rizal, Bataan, Laguna, Tayabas, Mindoro.). Common in open grasslands and waste places, but may be present in abundance too along the roads like *E. mollis*. It flowers from December to April. In habit it resembles that of *E. mollis*. Accidentally introduced at an early date. It has been reported previous to 1837. Blanco mentioned it. Doubtless it is a native of tropical America. Pantropic in distribution.

Field No. 1632.

ELEPHANTOPUS SPICATUS Aubl. (Plate XXX, fig. 54.)

Distroptus spicatus Case.
Ageratum dubium Blanco.
Elephantopus dubius Blanco.

Local names: Dila-dila (Tag.); dilang-aso (Tag.); maratabako (Ilk.); supsuput (Bon.).

An erect rather stiff, sparingly appressed-pubescent or nearly glabrous herb. Heads in clusters in the axils of every much reduced leaves. Achenes clay color, differs from two previous species in size and in the characters of the awns, ribbed, hirsute, hairs 0.5–1.0 mm. long, shining; 4.2–6.2 mm. long, awns about as long, 5 in number, dilated, and laciniate-cleft at the base, unequal, 3 straight and short, 2 longer and abruptly curved and again curved upward, barbs arranged upward.

Batan Islands and northern Luzon to Mindanao, in most islands and provinces. Common in waste places in the settled areas generally. In habit it resembles the two previous species. The achenes as in the two previous species are dispersed to a considerable distance by means of their barbed awns. It flowers from December to April. Accidentally introduced at an early date. Spontaneous. It is a native of Mexico, now also occurring in the Marianne Islands, Formosa, southern China, and Java.

Field No. 1649.

SYNEDRELLA NODIFLORA (Linn.) Gaertn. (Plate XXX, fig. 55.)

Verbesina nodiflora Linn.
Blainvillea latifolia Walp.

Local name: Fantankuen (Ilk.).

An annual, dichotomously branched, glabrous or sparingly hairy herb. Heads sessile. Flowers yellow. Achenes blackish brown those of the ray-flowers dorsally compressed, oblanceolate, 2-winged, the wings lacerate, those of the disk few, compressed, oblinear, 3-angled, often muricate, the angles terminating in spines awns, cinnamon buff, 2–3 long ones, and 2–3 sessile at the base between the long ones, barbed upward, shorter or almost as long as the seed proper, dorsally compressed achenes with apical awns 5.0–5.2 mm. long, 1.0–1.2 mm. long without the spines; achenes from the disk excluding the awns, 3.8–4.2 mm. long, 0.8–1.0 mm. wide.

It is a very common weed about Manila, and also in other towns in the Islands. It is quite abundant under the bushes and under the shade of trees. It flowers from September to February. So far there is no use found. As a weed it is not

considered troublesome. The spines in the achenes make the dispersal of the seeds very effective. It is a native of Mexico, and was probably introduced into the Philippines in early Spanish days. Spontaneous. Pantropic in distribution.

Field No. 1732.

ECLIPTA ALBA (Linn.) Hassk. (Plate XXX, fig. 56.)

Verbesina alba Linn.
Eclipta parviflora Wall.
Anthemis cotula Blanco.
Artemisia viridis Blanco.
Eclipta erecta Linn.

Local names: Karimbuaya (Ilk.); tultusilan (Ilk.); yayod (Iv.).

A decumbent, spreading, or sometimes suberect, strigillose, annual herb. Heads ovoid. Achenes cinnamon-buff or orange-cinnamon, surface rugose, angles quite prominent, otherwise, as a whole smooth, apex slightly hirsute, truncate, 2-aristate, 2.2–2.8 mm. long, 0.6–1.2 mm. wide, awns 0.1–0.3 mm. long.

An ubiquitous weed in low damp lands, in the rice paddies, and in the settled areas of the Philippines. In the rice paddies, the seeds are scattered by means of running water especially during the flooding period. The seeds fall on the ground, and are carried from paddy to paddy by the running water. The seeds germinate simultaneously with the rice, and often the plants grow under rice. It flowers all the year. It is not a very pestiferous weed, as it can be eradicated by simply pulling the plants before seeding. Accidentally introduced. Spontaneous. Its origin is unknown. Pantropic in distribution.

Fied No. 1690.

COSMOS CAUDATUS HBK. (Plate XXX, fig. 57.)

Local names: Tuktukao (Bon.); turay-turay (P. Bis.).

A coarse, erect, branched herb. Achenes wood brown, fusiform, 4-angled, angles extending to the apex of the beak, faces grooved at the middle, nearly smooth, with very few spines near the beak and at long slender beak scabrid and spiny, apex of beak with two spreading retrorsely scabrid awns; achenes including beak very long, 18.5–28.5 mm. and 0.8–1.1 mm. wide.

This plant was introduced from Mexico for ornamental purposes probably in the first half of the 19th century. Blanco in his Flora de Filipinas in 1845 mentions it under the name of *Coreopsis gracilis*. The plant is found occasionally in cultivation, but abounds as a weed in open waste places, fallow lands, etc., at low and medium altitudes. It is now thoroughly natu-

ralized. It is a native of tropical America, now pantropic in distribution.

Field No. 1695.

BIDENS LEUCORRHIZA (Lour.) DC. (Plate XXX, fig. 58.)

Coreopsis leucorrhiza Lour.
Bidens chinensis Willd.
Bidens bipinnata Blanco.
Bidens leucantha Usteri.
Bidens pilosa Vidal.

Local names: Anguar (Gad.); angguat (Ig.); puriket (Ilk.); purpurikit (Ilk.); pulut (Ig.); tagad (Tag.).

An erect, branched, usually more or less hairy herb. Heads long, peduncled. Achenes blackish, fusiform, angular, angles more or less rounded, spinous, spines arranged upward, surface covered with minute and nicely compacted tubercles, awns usually three, bristles sharp, pointed, and pointing downward, 11.8–13.5 mm. long, awns very much shorter than the body of the achene.

Very common weed in Batan Islands and northern Luzon to Palawan and Mindanao. In open waste places, thickets, etc., from sea level to an altitude of 2,500 meters. The effective dispersal of the seeds is due to the spinous achenes, and the presence of bristles which are pointed downward. These bristles easily cling to clothes or to coat or hair of animals. It flowers from October to November, and probably in other months. Accidentally introduced. Spontaneous. Origin unknown. Also found distributed in the Old World tropics. It is very often confused with *Bidens pilosa* Linn.

Field No. 1503.

BLUMEA BALSAMIFERA (Linn.) DC. (Plate XXX, fig. 59.)

Conyza balsamifera Linn.

Local names: Alibhum (P. Bis.); alimon (P. Bis.); bukadkad (S. L. Bis.); kaliban (Tagb.); sambong (Tang.); takamain (Bag.); sambun (Sul.).

A coarse, tall, erect, suffrutescent, strongly aromatic herb, densely and softly pubescent. Flowers yellow. Achenes light pinkish cinnamon, very small, cylindric, covered with stiff hairs, pappus white, the hairs 1-seriate, slender, longer than the seed, 0.8–1.0 mm. long.

Northern Luzon to Palawan and Mindanao, in all or most islands and provinces. Usually a common weed in open grasslands at low and medium altitudes. The leaves are much used by the natives for cleaning dishes and household articles covered or smeared with grease. The leaves probably possess a chemical

which has a soap action. The leaves are also used for driving lice from hens' nests. It is scattered to some distance by the hairs at the apex of the achene, which make the achene buoyant and a flyer. Accidentally introduced? Spontaneous. Origin unknown. It flowers from February to April. Distributed through India to southern China, through Malaya to the Moluccas.

Field No. 1716.

ABBREVIATIONS ADOPTED FOR DIALECTS[1]

Ap.	= Apayao.	Kul.	= Kulaman.
Bag.	= Bagobo.	Klg.	= Kalinga.
Bik.	= Bikol.	Kuy.	= Kuyonon (Cuyo Islands).
Buk.	= Bukidnon.	Lan.	= Lanao.
Bon.	= Bontoc.	Mag.	= Maguindanao.
Bil.	= Bilaan.	Mang.	= Mangyan.
P. Bis.	= Panay Bisaya.	Mand.	= Mandaya.
C. Bis.	= Cebu Bisaya.	Mbo.	= Manobo.
S. L. Bis.	= Samar-Leyte Bisaya.	Neg.	= Negrito.
Ak. Bis.	= Aklan Bisaya.	Pang.	= Pangasinan.
Dum.	= Dumagat.	Pamp.	= Pampanga.
Eng.	= English.	Sbl.	= Sambal (Zambales).
Gad.	= Gaddang.	Sp.	= Spanish.
Iv.	= Ivatan.	Sul.	= Sulu (Jolo).
Ibn.	= Ibanag.	Sub.	= Subanun.
Ilk.	= Iloko.	Tag.	= Tagalog.
Ig.	= Igorot.	Tagb.	= Tagbanua.
Ism.	= Isamal.	Tagk.	= Tagakaolo.
Ilg.	= Ilongot.	Ting.	= Tinggian.
Is.	= Isinai.	Tir.	= Tirurai.
If.	= Ifugao.	Yak.	= Yak.

BIBLIOGRAPHY

1. BACON, R. F. The physiologically active constituents of certain Philippine medicinal plants. Philippine Journal of Science. *1*: 1007–1036. 1906.
2. BEAL, W. J. The vitality of seeds. Botanical Gazette. *42*: 140–143. 1905.
3. BEAL, W. J. Seeds of Michigan weeds. Michigan Experiment Station Bulletin 260. 2–182, figs. 215. 1910.
4. BOLLEY, H. L. Weeds and methods of eradication. Weed control by means of chemical sprays. North Dakota Experiment Station Bulletin 80. 513–573, figs. 25. 1908.
5. CATES, H. R. The weed problem in American agriculture. U. S. Department of Agriculture Yearbook. 205–215, pls. 5. 1917.
6. CATES, J. S. and SPILLMAN, W. J. A method of eradicating Johnson grass. U. S. Department of Agriculture Farmers' Bulletin 279. 5–16, figs. 8. 1907.

[1] Adopted from Merrill's, "Enumeration of Philippine plants."

7. CLARK, G. H. and FLETCHER, J. Farm weeds of Canada. Ottawa Department of Agriculture pp. 103, pls. 56. 1906.
8. COE, H. S. Weeds. South Dakota Station Bulletin 150. 380–453, figs. 29. 1914.
9. CUNNINGHAM, J. C. Roots and rootstocks of weeds. Iowa Geological Survey Bulletin 4. 643–654, figs. 10. 1913.
10. DEWEY, L. H. Weeds in cities and towns. U. S. Department of Agriculture Yearbook. 193–200, figs. 5. 1898.
11. IBID. 263–286, figs. 15. 1896
12. DEWEY, L. H. Weeds: How to kill them. U. S. Department of Agriculture. Farmers' Bulletin 28. 7–30. 1905.
13. DUVEL, J. W. T. The vitality of buried seeds. U. S. Department of Agriculture. Farmers' Bulletin 83. 7–22, pls. 1–3. 1905.
14. FRIER, G. M. Indiana weeds: their control and eradication. Proceedings Indiana Academy of Science. 323–334, figs. 9. 1910.
15. GARMAN, H. Some Kentucky weeds and poisonous plants. Kentucky Station Bulletin 183. 255–339, pls. 43. 1914.
16. GEORGIA, ADA E. A Manual of Weeds. New York. 593 pp., figs. 387. 1914.
17. HALSTEAD, B. D. Notes on weeds. New Jersey Station Report. 313–340. 1891.
18. IBID. 350–381. 1892.
19. HELYAR, J. P. Weed control. New Jersey Station Circular 60. 3–12. 1916.
20. HILLMAN, F. H. Nevada weeds. Nevada Station Bulletin 21. 15 pp., figs. 4. 1893.
21. HITCHCOCK, A. S. The genera of grasses of the United States. U. S. Department of Agriculture Bulletin 772. 1–307. 1920.
22. MERRILL, E. D. A dictionary of plant names of the Philippine Islands. Philippine Department Interior, Bureau of Government Laboratories. Publication No. 8. 193 pp. 1903.
23. MERRILL, E. D. The American element in the Philippine Flora. Philippine Department Interior, Bureau of Government Laboratories. Publication No. 6. 19–36. 1903.
24. MERRILL, E. D. Notes on the Flora of Manila with special reference to the introduced element. Philippine Journal of Science. Section C. *7:* No. 3. 145–208. 1912.
25. MERRILL, E. D. The Flora of Manila. Bureau of Science, Manila. 490 pp. 1912.
26. MILLSPAUGH, C. F. Weeds of West Virginia. West Virginia Station Bulletin 23. 215–310, figs. 66. 1892.
27. NORTON, J. B. S. Maryland weeds and other harmful plants. Maryland Agricultural Station Bulletin 155. 71 pp., figs. 56. 1911.
28. OSWALD, W. L. and BOSS, A. Minnesota weeds, III. Minnesota Agricultural Experiment Station Bulletin 126. 5–43, figs. 25. 1918.
29. PAMMEL, L. H. The problem of weeds in the West. Proceedings of Iowa Academy of Science *17:* 34–46. 1910.
30. PAMMEL, L. H. and KING, C. M. The general characters of seeds. Iowa Geological Survey Bulletin 4. 405–502, figs. 236–382. 1913.
31. PAMMEL, L. H., KELLOG, H. S., and KING, C. M. History and bibliography. Iowa Geological Survey Bulletin 4. 821–872. 1913.

32. PALMER, E. L. A seed key to some common weeds and plants. Proceedings of Iowa Academy of Science *23:* 335–394, figs. 41. 1916
33. RICHMOND, G. F. Philippine fibers and fibrous substances: Their suitability for paper making. Philippine Journal of Science *1:* 433–463. 1906.
34. RIDWAY, R. Color standards and color nomenclature. Maryland. 43 pp., pls. 53. 1912.
35. SELBY, A. D. A second Ohio weed manual. Ohio Agricultural Experiment Station Bulletin 175. 291–384, figs. 73. 1906.
36. SHAW, T. Weeds and how to eradicate them. St. Paul. 210 pp., figs. 22. 1896.
37. SPILLMAN, J. J. Extermination of Johnson grass. U. S. Department of Agriculture Bulletin 72. 14 pp., pls. 3, figs. 4. 1905.
38. STONE, A. L. State seed inspection and weed control. Wisconsin Station Bulletin 254. 3–39, figs. 28. 1915.
39. TAVERA, T. H. PARDO DE. The medicinal plants of the Philippines. Philadelphia. 269. pp. 1901.
40. TOWMEY, J. W. Something about weeds. Arizona Station Bulletin 22. 32 pp., figs. 12. 1897.
41. WESTON, W. L. Philippine downy mildew of maize. Journal of Agricultural Research *19:* 97–122. 1920.

TABLE I.—*Summary of families, genera and species, showing methods of introduction, and habits of growth, origin, and geographic distribution of various forms.*

Families, Genera and species	Introduced					Origin				Geographic distribution																				
	Purposely	Accidentaly	Cultivated	Partly cultivated	Spontaneous	Mexico	Tropical America	Oriental or European	American	Unknown or doubtful	Marianne Islands	Caroline Islands	Formosa	Borneo	India	South China	Malaya	Moluccas	Java	Mauritius	Mascarine Islands	Africa	Japan	Tropical Asia	Australia	Polynesia	Old World Tropics	New Guinea, Andamank and Riu Kiu	United States	Pantropic
GRAMINEAE:																														
1. Coix lachryma-jobi L.	×	×?	×		×			× [c]																						×
2. Imperata cylindrica (Linn.) Beauv.		×?			×					×							×					×	×	×	×	×				
3. Saccharum spontaneum L. subsp. indicum Hack.		×?			×					×					×	×	×	×								×				
4. Andropogon halepensis (L) Brot. var. propinquus (Kunth.) Merr.		×?			×			× [a]																						×
5. Paspalum longifolium Roxb.		×?			×					×					×		×													
6. Paspalum scrobiculatum L.		×?			×					×																				×
7. Panicum flavidum Retz.		×			×					×							×						×	×						
8. Panicum crus-galli L.		×?			×				×																				×	×
9. Panicum repens L.		×?			×			×																						×
10. Panicum colonum L.		×?			×					×																				×
11. Setaria geniculata (Lam.) Beauv.		×?			×					×																				×
12. Cynodon dactylon (Linn.) Pers.	×		×					× [a]																						×
13. Eleusine indica (Linn.) Gaertn.	×?				×			×																					×	×
CYPERACEAE:																														
1. Cyperus difformis L.		×?			×					×																	×			
2. Cyperus iria L.		×?			×					×																	×			
3. Cyperus compressus L.		×?			×					×																				×
4. Fimbristylis annua (All.) R&S.		×?			×					×																				×
5. Fimbristylis miliacea (Linn.) Vahl		×?			×					×																				×
6. Scirpus grossus L.		×?			×					×					×		×													
7. Scleria scrobiculata Nees.		×?			×					×																		×		
COMMELINACEAE:																														
1. Commelina benghalensis L.		×?			×					×							×					×	×	×						
AMARANTHACEAE:																														
1. Celosia argentea L.	×				×				×																					×
2. Amaranthus spinosus L.		×			×		×																						×	×

3. Amaranthus viridis L.	×?				×					×																				×
4. Achyranthes aspera L.		×			×			×																						×
PORTULACACEAE:																														
1. Portulaca oleracea L.	×				×					×																			×	×
PAPAVERACEAE:																														
1. Argemone mexicana L.	×				×	×																								×
CAPPARIDACEAE:																														
1. Gynandropsis gynandra L.		×?			×					×																				×
LEGUMINOSAE:																														
1. Mimosa pudica L.	×				×				× [b]																				×	×
2. Cassia occidentalis L.		×			×		×																							×
3. Cassia tora L.		×			×		×																							×
4. Desmodium triflorum (Linn.) DC.		×?			×					×																				×
5. Alysicarpus nummularifolius (Linn.) DC.		×			×			×																						×
6. Indigofera hirsuta L.		×			×			×																			×			
7. Indigofera suffruticosa Mill.		×			×		×																							×
8. Sesbania cannabina (Retz.) Pers.		×			×					×					×		×													×
OXALIDACEAE:																														
1. Biophytum sensitium (Linn.) DC.		×			×			×?																						×
TILIACEAE:																														
1. Triumfetta semitriloba Jacq.		×			×				×																					×
2. Corchorus capsularis L.	×		×		×			× [a]																						×
3. Corchorus acutangulus Lam.		×			×			× [c]																						×
4. Corchorus olitorius L.	×				×			× [d]																						×
MALVACEAE:																														
1. Abutilon indicum (Linn.) Sweet		×		×	×			×																						×
2. Malachra capitata L.		×			×		×																							×
STERCULIACEAE:																														
1. Melochia concatenata L.		×			×					×																				×
OENOTHERACEAE:																														
1. Jussiaea linifolia L.		×			×		×																							×
LABIATAE:																														
1. Hyptis suaveolens (L.) Poir.		×			×		×																							×
2. Leucas aspera (Willd.) Spreng.		×			×					×					×				×	×										×
3. Leucas lavandulifolia Sm.		×			×					×					×	×	×				×									
4. Leucas javanica Benth.		×?			×					×			×						×											
RUBIACEAE:																														
1. Borreria hispida (Linn.) K. Schum.		×?			×					×					×	×	×													
COMPOSITAE:																														
1. Ageratum conyzoides L.		×			×	×																								
2. Elephantopus scaber L.		×			×		×																							×
3. Elephantopus mollis HBK.		×			×	×					×	×	×	×																×
4. Elephantopus spicatus Aubl.		×			×	×					×	×	×	×		×														
5. Blumea balsamifera (Linn.) DC.		×?			×					×					×	×	×	×												
6. Synedrella nodiflora (Linn.) Gaertn.		×			×	×																								
7. Eclipta alba (Linn.) Hassk.		×			×					×																				×
8. Cosmos caudatus HBK.	×				×		×																							×
9. Bidens leucorrhiza (Lour.) DC.		×			×					×																		×		

× [a] Mediterranean region. × [b] Brazil. × [c] Native of the Old World. × [d] India.

THE POLO COPRA DRIER

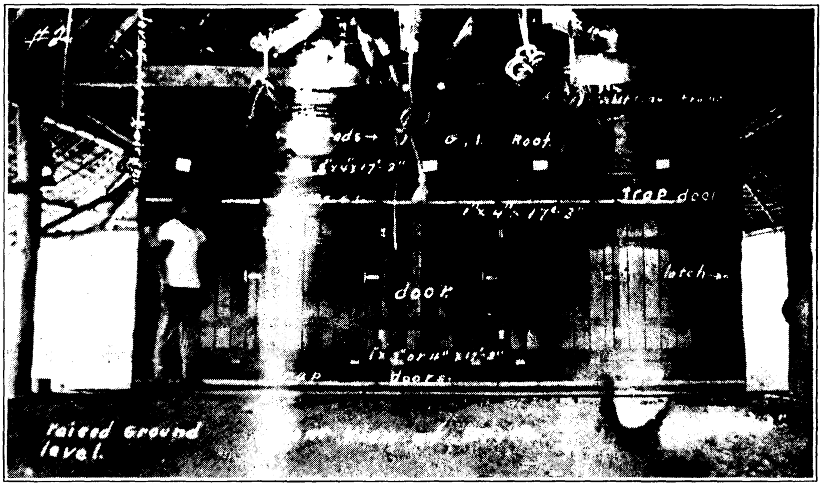
By H. J. DETRICK, *Manager, Polo and Pamplona Coconut Plantations*

Construction.—The "Polo Copra Drier" consists of a box-like chamber made of wood. As constructed it is 7 feet, 6 inches wide by 17 feet, 3 inches long and contains five tiers of trays, each tier having ten trays. The chamber is lined inside with gasoline and petroleum tins to make it more nearly air tight, as the boards will shrink considerably after being subjected for some time to the heat. The heating system consists of an old Scotch type boiler, 4 feet in diameter by 16 feet in length, having two 16-inch flues instead of the small flues used in modern boilers. This boiler is placed immediately under the chamber and is approximately 4 feet from the lowest tray. Ventilation is controlled by means of small vents in the galvanized iron walls below the tiers of trays, and by the introduction of ordinary stovepipe dampers in the ventilating chimneys at top of dryer.

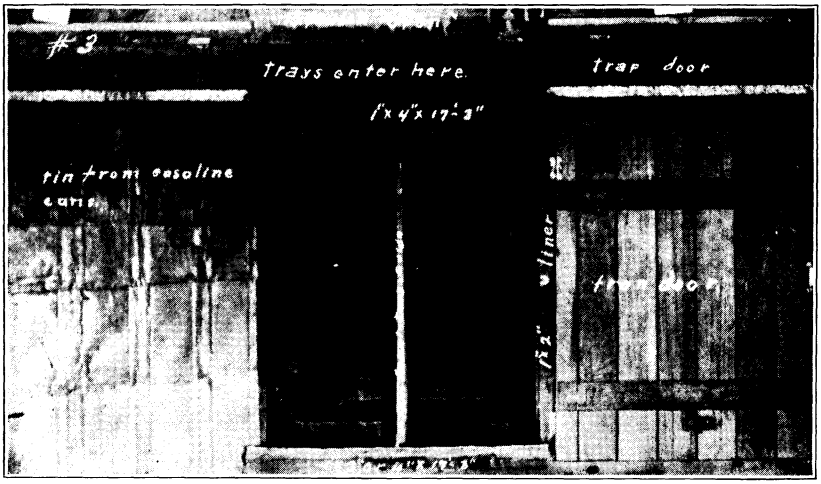
The distinguishing feature of this new dryer is its tray-lifting and shifting mechanism, which readily places it in the class of dryers known as "the continuous process type." By means of the shifting mechanism the trays of fresh meat are inserted at the top of each section and thereafter are gradually shifted to the lower levels until by the time it is nearly completed the copra has arrived at the lowest position from where it is finally removed from the dryer.

The chamber.—This is built of 1 inch by 6 inches T. & G. stuff, with the roof of galvanized iron of about 22 gauge. The lower three feet of the walls of the chamber are also of galvanized iron. By using galvanized iron this high a minimum of wood is exposed to the rather high temperature in the lower regions of the chamber.

For each tier, or section of trays, there are three doors at the front and two at the back. Two of the three doors at the front are eight inches high and are the only ones regularly used in the operation of the dryer. The raw coconut meat enters at the top door and when completed leaves by the door at the bottom. The middle door, as well as the two at the back are seldom used except when putting in the initial charge,



(*a*) Front view of the Polo Copra Drier in operation at the Polo Coconut Plantation, Tanjay, Oriental Negros.



(*b*) The Polo Copra Drier; showing the trays in position in one section.

at which time it is necessary to dispense with the shifting device. The empty trays could, however, be put into the chamber as the completed copra at the end of the drying period each month is withdrawn, in which case the shifting device could be used during the initial filling. It might be preferable to some to divide the two back doors vertically instead of horizontally, but it appears that the latter way permits less loss of heat when examining copra at the back end of trays.

The frame work merely consists of wall studs, 2 inches by 4 inches; tray studs 2 inches by 4 inches, between which rest the tiers of trays; the upper cross tie beams, 2 inches by 4 inches, supporting both sets of studs; the two inner longitudinal tie beams, 2 inches by 4 inches, which hold the lower ends of all tray studs in place; the two plates, 2 inches by 4 inches, or larger, on which the structure rests, and the rafters, 2 inches by 4 inches, serving to support the hip roof. Careful attention should be given to the fact that there are no cross beams below the trays other than those which serve as lower tray rails. If cross pieces were placed at lower levels than this there might be some danger from fire. If the space in the chamber between the top of the boiler and the lowest tray were less than four feet there would be danger of scorching the copra frequently when a high temperature is maintained. At the same time this space is sufficient for convenient mixing of the cold and hot air, and the distribution of same thereafter.

Trays.—The trays of the dryer are of the same size as our sun drying trays, in fact some of the sun drying trays were used for the dryer, by substituting $\frac{1}{2}$ inch mesh poultry netting for the original *amacan* bottoms. The tray proper is 3 feet by 6 feet 6 inches, outside measure, which gives for the entire fifty trays nearly 1,000 sq. feet. The sides of the tray frames may be left about five inches longer than the tray proper so that $2\frac{1}{2}$ inches at each end can be utilized for handles which will be found of great convenience in handling the trays. The handles should not be longer than this since they would then interfere with the doors. The lower half of the $2\frac{1}{2}$ inch extension at each end of the 1 inch by 3 inch side piece of frame should be cut away instead of the upper half as indicated in figure 1, Sheet No. 2. Figure No. 4, Sheet No. 3 shows exactly how the handles should be cut.

When cutting tray cross pieces, considerable precaution should be taken to have all trays of equal width, for if they vary more than one-eighth of an inch more or less annoyance will be experienced. The chief difficulty in securing trays of

equal width, lies in the fact that boards, here, vary so much in thickness.

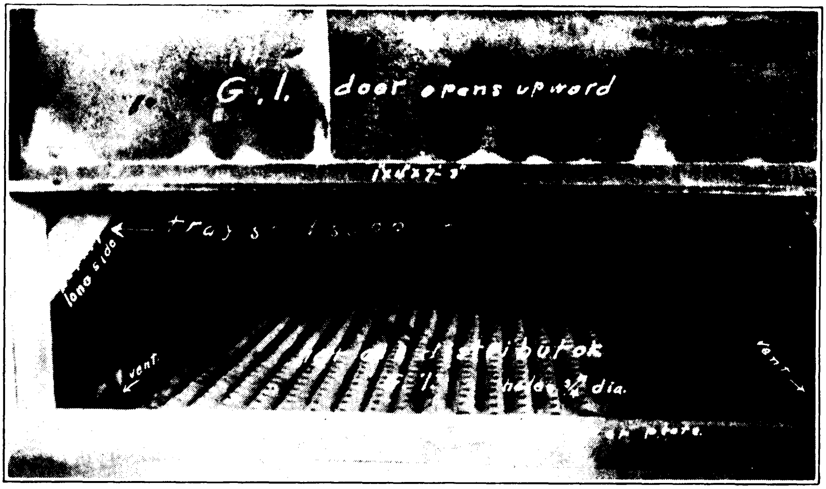
The 2 by 3 inch pieces in the corners of the trays serve two purposes, one that of adding strength and rigidity to the tray, and the other as a spacer to obtain proper distances between the trays. These corner pieces should be made of wood which will not split easily when nails are driven into them near the ends. Lauan and some of the softer grades of Apitong have proved satisfactory for this purpose.

As constructed the distance between any two trays is $2\frac{1}{2}$ inches and this plus the width of the frame side piece, 3 inches, makes this corner block or spacer just $5\frac{1}{2}$ inches long. A strip of hard wood, approximately $\frac{3}{4}$ inch in thickness, is nailed to the bottom of the tray to serve as a tray runner on which the tray slides in and out of the chamber. Thus the depth of the space occupied by each tray is $6\frac{1}{4}$ inches.

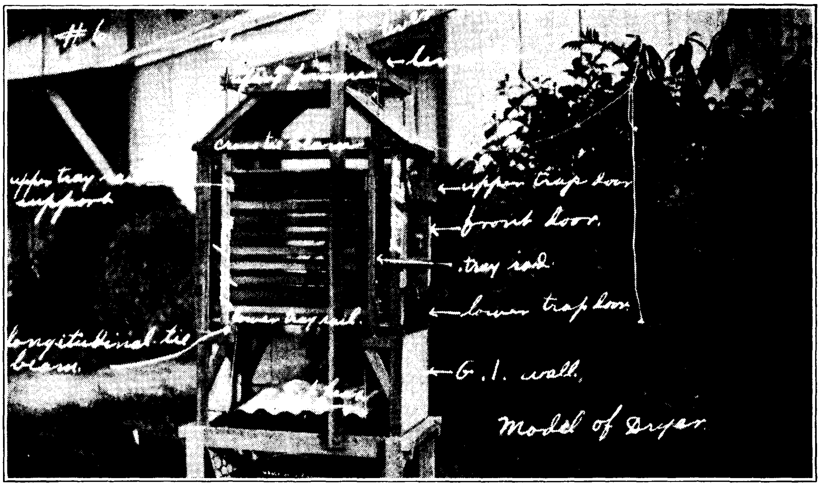
Some experimenting was done here with one tier of trays with one inch spacing instead of $2\frac{1}{2}$ inches. While it was possible to put 14 trays in this tier, formerly containing but ten trays, the increased capacity for turning out completed copra was not proportional to the increase in tray surface, and besides this the 1 inch space was not sufficient to insure easy and proper action of the tray rod hooks. Therefore the idea of increasing the capacity of the dryer by decreasing the spacing between the trays was abandoned. In the event, however, that any one should care to add one or two trays to each tier, and still maintain the present spacing, it would be necessary merely to add $6\frac{1}{4}$ inches to the height of all studs, and the elevation of upper tray rails, for each tray that is added.

An examination of the photographs and blue prints will show that each tier of trays employs but two pairs of rails, one pair at the bottom and one at the top. These top rails are so arranged that each one serves the tier of trays on either side. Th operation of these rails will be explained under "Shifting Mechanism" later on.

Provision was made for taking care of the smaller pieces of copra by covering about twenty-five trays with ordinary wire screen in addition to the $\frac{1}{2}$ inch mesh poultry netting. Although this wire screen has been in use for one year and a half it is still in good condition. To prevent small pieces of copra from sifting down to the regions of the boiler, a very lightly constructed tray with wire screen only is placed just below the



(*a*) Polo Copra drier, showing the open door above the furnace, and a perforated corrugated sheet iron placed above the boiler below the drying chamber serving as baffleplate.



(*b*) Model of one section of the Polo Copra Drier, showing details.

lowest tray and rests on the two tie beams running lengthwise of the chamber.

A set of fifty extra trays were made in order to provide a sufficient supply of raw copra for the men operating the dryer. This arrangement is found to be especially convenient for the night runs.

Shifting mechanism.—As shown on sheets No. 2 and 3 of the plans,[1] and by the various photographs, the principal elements of the "tray shifting mechanism" are:

A long lever 2″ × 8″ × 18′ and 6″ which has for a fulcrum a 3″ × 12′ × 18′ timber;

A $1\frac{1}{4}$″ rope, attached to outer end of the long arm of lever;

A lifting frame made of 2″ × 4″ stuff, and connected with the long lever by means of four half-inch rods through a long clevis;

A set of four tray rods, terminating in hooks at the lower ends, carried by the lifting frame;

Four short arms attached near the upper ends of the four tray rods for securing a uniform movement of these rods in the process of raising and lowering the tier of trays;

A small spring about 14 inches in length, of sufficient strength to cause the four rods to return, when released, to their normal position;

Four bumpers near lower ends of tray rods to secure a uniform level of tray rod hooks when released to engage trays;

Four small tray rod guides, of $\frac{1}{4}$″ × 1″ flat iron (see fig. 3, on Sheet No. 3 of plan) curved at one end to receive tray rods near their lower ends and to prevent these rods from leaving their proper position; and

A counterweight of old iron attached to end of the short arm of the long lever, of sufficient weight to balance the long arm of the lever.

The lever.—This consists of a 2″ × 8″ × 18′-8″ piece of fairly tough wood—apitong will do—which naturally has one very long arm and a very short one. A counterweight is attached to the extreme end of the short arm and should be of sufficient weight to just balance the long arm of the lever, thus permitting the entire weight of the lifting frame and the tray rods to carry themselves, in their downward movement, past any slight friction that might occur at times.

[1] Four sheets of blue prints constituting the plan of the Polo Copra Drier, will be forwarded to applicants at the cost of $0.50 United States currency.

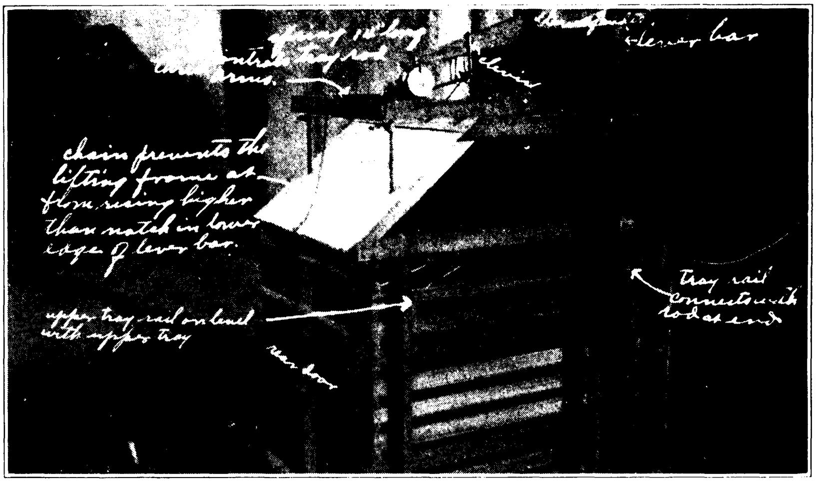
The 1″ × 6″ fulcrum pin—the pin on which the lever rests—passes at right angles through the lever about 2 inches from the lower edge. A notch slightly more than one inch in depth is cut into the lever bar at the point of intersection with the lever, so that the fulcrum pin may rest on the lever bar, thereby giving the lever an easy rocking motion. On each side of the lever and lever bar there is a pair of what might be termed "lever guides" of 2″ × 4″ × 12″ pieces which prevent any twisting or side movement in the lever. (See lever sheet No. 1 of plan.)

The lever bar.—This is a 3″ × 12″ × 18′ piece of apitong running the full length of the dryer and rests on two supports only, one at each end. No intervening supports should be placed between those at the ends as they would interfere with the lifting frames. But since the middle portion of this lever bar carries great weights at times it requires considerable strength and this is provided for in the form of a triangular brace somewhat similiar to a triangular truss. (See Sheets Nos. 1 and 4 of plan.)

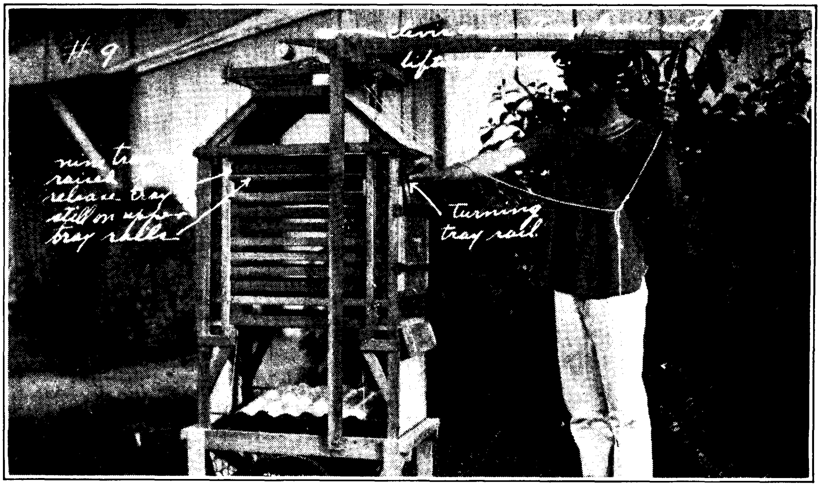
The long lever rope should be about $1\frac{1}{4}$ inches in circumference in order to provide an easy and firm grip for the operator.

The lifting frame is one of the most important elements of the "shifting device", since it carries the set of four tray rods. and is attached to the long lever by means of the four supporting rods of $\frac{1}{2}$ inch round iron, and a long clevis which together form a pivot joint. The object of constructing the model of the dryer was chiefly to discover some means for controlling the awkward action of this particular joint. Any one may readily appreciate the fact that loading ten trays so that they would just balance would be difficult, indeed, and if the load should not balance then the trays would tilt one way or the other through this joint and thereby defeat the desired end. The two "tray guides" overcame the difficulty and brought about the desired results. See Plate XXXI–*b* of the dryer, and various others of the model. These guides are removed when putting in the initial charge of copra, unless the chamber is left filled with empty trays at close of the previous drying period, in which case they need not be removed.

In order to maintain proper proportions and distances between the moving elements of the tray shifting device, the four half inch rods connecting the lifting frame to the long lever should enter the side pieces of frame from beneath and



(*a*) Model of a section of the Polo Copra Drier, showing details.



(*b*) Model of a section of the Polo Copra Drier, showing details.

near the ends. At the same time notches about two inches deep should be cut into the under edge of the lever bar at points where the lifting frame intersects so that sufficient clearance may be obtained for the removal of the lower tray.

Tray rods.—The set of four tray rods are carried by the lifting frame. These are made of $\frac{5}{8}$ inch iron terminating at the lower ends with right angle bends to form hooks for engaging the trays, and at the top ends with threads to receive the supporting nuts.

The holes in the frame through which the above rods pass should be slightly larger than the rods in order to avoid friction when these are rotated. The nuts should allow the rods to turn freely and without any binding. To prevent the possibility of the nuts turning with the rods, slots may be cut across the corners of each nut which are then wired to lifting frame. If the lower ends of the tray rods are set up to about $\frac{3}{4}$ inch in diameter, they will be found to be more satisfactory than if this is not done and they will never bend. (See Rod in fig. 5, Sheet No. 3.)

Tray rod arms.—Each tray rod carries one arm to provide for its rotating movement. The front pair of arms are approximately twice the length of the back pair, so as to give sufficient leverage for the easy rotating of the four rods. Each long arm at the front is connected to a short arm at the back by means of a $\frac{3}{8}$ inch rod. A wire connects up the spring at the back of the frame to the front arms where the $\frac{3}{8}$ inch connecting rods are attached.

These arms should come to rest at an angle of about 45 degrees with the sides of the lifting frame,—inside of the frames—and when in operation they should rotate clockwise through about 90 degrees. (See Fig. No. 2, Sheet No. 2.) To give added strength, these arms may be twisted as close as possible to the clamp end, so that the faces of the clamps and the faces of the remainder of the arms will be at right angles to one another. These clamp ends should be attached to the tray rods just below the lifting frame, $\frac{1}{2}$ inch space between frame and clamp being sufficient.

In order to prevent these arms from turning or slipping on the tray rods, the latter may be slightly flattened at the point of attachment of the arms. To do this properly the tray rods should be in proper position so that the angle of the flattened portion is in correct relation to the hook at the lower end of the tray rod. A small cord is attached to the inner ends of

Missing
Page

Missing Page

the fireman may over or under feed the fire for a short time. In case of the use of but half of a boiler, a large quantity of old scrap iron could be added either to the inside or the outside and thereby maintain a temperature practically as uniform as if boiler were entire. In addition to this that portion of the smoke stack under the chamber and leading back from the boiler could be so constructed that a maximum quantity of heat would be radiated therefrom.

The fuel consumed consists of husks and shells of the coconut. Since all the nuts are opened in the field, those husks and shells required for fuel are brought in from the field to headquarters.

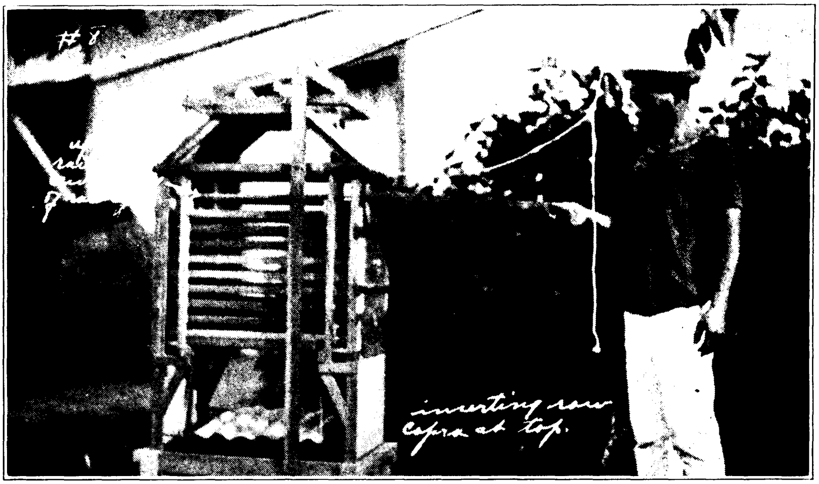
The walls in the boiler pit are lined with rough stones and cement. The boiler itself should be entirely uncovered if the maximum of heat is desired.

Perforated galvanized iron placed above the boiler as shown in the Plates aids greatly in bringing about a fairly even distribution of heat throughout the drying chamber.

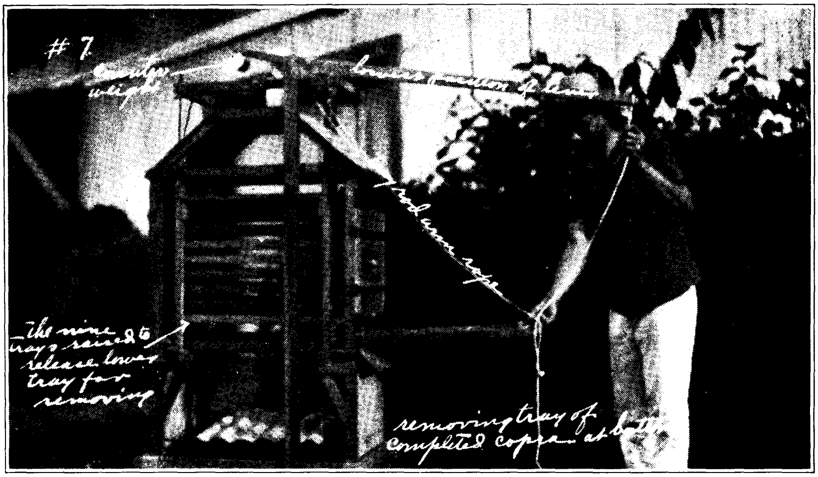
By this means a large amount of surplus heat delivered at the zone of greatest heat, near the front end of boiler, is carried farther back, with the result that the temperature is nearly the same at both ends of the dryer at the same tray levels. In most cases the rear end of the galvanized iron is considerably higher than the front end, the proper angle of inclination being found by a little experimenting. The proper inclination will depend somewhat upon the length of the boiler used, and the force of draught obtained.

As shown in Plate XXXII–*a* of the dryer, the 2″ × 4″ × 7′–3″ piece at lower side of front end door, is placed about 10 inches above the lower side plate so there will be no danger from fire. The space beneath this may be closed with either cement or galvanized iron, as desired.

Ventilation.—The circulation of air throughout the chamber is aided and accelerated by the air vents at the bottom of the galvanized iron walls, and the three ventilating chimneys as mentioned above. These chimneys are 14 inches in diameter, and the height of the one at center is 18 feet, while the other two are but 3 feet high and enter the center one at opposite sides. The two short pipes thus defeat their own purpose in that the force of the air current in one offsets that of the other. For this reason one of the short pipes has since been disconnected from the center pipe. If these two pipes were joined to the one in the center at different levels a good draught would be obtained in all. Each pipe has an ordinary stove-



(*a*) Model of a section of the Polo Copra Drier illustrating insertion of a tray filled with coconut meat.



(*b*) Model of a section of the Polo Copra Drier illustrating removal of a tray of dried copra

pipe damper which may be closed or opened to aid in controlling the temperature.

Operation.—The capacity of this dryer depends upon a number of factors, some of which are: temperature, size and uniformity of the pieces of raw coconut meat, the quantity of raw meat placed in the tray and whether it is turned face down, and last but not least of these factors is the amount of moisture left in the copra when it is turned out of the dryer.

Temperature.—In the light of our experience, copra appears to be able to withstand a higher temperature without injury as it nears completion than at the time when it first enters the dryer. In other words, the drier the copra the higher the temperature it endures without scorching.

In this dryer the zone of the greatest heat is naturally near the bottom. Here the tray-shifting mechanism comes into play and makes possible the entrance of the raw coconut meat at the top of the chamber, where the temperature is lowest, and the withdrawal of the copra at the lowest level, where the temperature is highest. After some experimenting we found that when the raw meat was subjected for any length of time to a temperature above 180 degrees, F., scorching was likely to occur, while the nearly dried copra would permit a temperature as high as 200 degrees without harmful effects. Therefore we attempt to maintain a temperature of 165 to 170 degrees, F., at the highest level where the fresh meat enters, and this usually means a tempetarure of 185 degrees in the hottest part of the dryer.

Sizes of raw coconut meat.—The most casual observer will note that the smaller the piece of meat the greater the surface area in proportion to volume, and consequently the rate of evaporation will be proportionately increased. Since much of the extracted meat remains in rather large pieces, some of these containing as much as 15 to 16 square inches, the entire lot is passed through a cutting machine, operated by hand, whereby the average size of the larger pieces is reduced to 4 or 5 square inches. This raw copra is then passed through a screen of $\frac{3}{4}$ inch mesh poultry wire netting where the larger pieces are screened out. By this method much over drying and under drying is obviated, and a more uniformly dried copra is secured. It is doubtful if this screening process would prove profitable where the completed copra contains more than 10 or 12 per cent of the original moisture.

In practice here, the pieces of raw copra are placed upon the trays promiscuously and in quantity about equal to one and one-half layers if it were laid out piece by piece. The smaller pieces previously screened out are placed in the trays in about double the quantity of the larger pieces, and yet dry in less time. With the temperature above mentioned an average of about 15 piculs of completed copra is turned out each day of 24 hours.

The cost of the dryer is about ₱1,100 including 50 extra trays.

No skilled labor whatever is required in the operation of the Polo Dryer, and thus the operating cost is proportionately less than it would otherwise be. Two men and a boy are usually in charge of the operation of the plant, though it is not uncommon for two men to do all the work. One man and the boy look after the changing of the trays while the other man does the firing. The cost of the two shifts, including rations, for the twenty-four hours is approximately ₱3, thereby making the cost of drying the copra about 20 centavos per picul.

Most any of the laborers, after a few trials, can operate the tray-shifting device, as it is simplicity itself. The movements in this operation are substantially as follows:

1. Pull the small rope attached to the front pair of tray rod arms until the tray rod hooks rotate to position parallel to sides of trays and are free to move upward;
2. Still maintaining the pull on the rod arms, pull the long lever down, by means of the large rope, the tray rod hooks come into contact, lightly, with the bumpers;
3. At this juncture release the tray rod arms permitting the hooks to engage the second tray from the bottom;
4. Now continue the downward pull on the long lever until the upper nine trays are lifted and are entirely free from the bottom tray (or until the lifting frame comes into contact with the 3″ × 12″ lever bar), then this bottom tray may be withdrawn with perfect ease through the lower trap door;
5. Next permit the long lever to return to its normal position and the first half of the operation is completed;
6. Open the upper trap door, turn the upper tray rails inward toward the tier of trays in order to receive the new tray of raw coconut meat;
7. With the newly inserted tray resting on the tray rails pull the long lever downward again until the original nine trays have moved up and disengaged this new tray from the

rails; now turn the two rails outward and permit the long lever to assume its normal position again.

This last movement permits the ten trays to come to rest on the lower pair of tray rails and the operation is completed with a minimum loss of heat, without disturbing the copra remaining in the dryer, with but slight effort on the part of the two men and within a very short space of time, in fact but a fraction of the time required to explain it.

Success of the dryer.—This plant was built in the early part of last year and has been in operation ever since. Up to date we are inclined to call it pretty much of a success. About one-half of the entire amount of copra produced here, since its installation has come from it, the remaining half having been dried in the sun by using the *amacan*-bottom trays. It is our opinion that mechanical drying systems cannot produce cheaper copra than the sun drying method, that is, where there is an abundance of bright sunshine. But the lack of sunshine during the periods of rainy weather oblige us to bring to our assistance a mechanical dryer.

Cost reduction.—In order to show to what extent our expenses in the production of copra have been reduced since the introduction of the Polo Dryer, the two following tables are given. During the 1921 period all copra was dried on the *amacan-bottom* trays and during the 1922 and 1923 period the sun drying was supplemented by the mechanical dryer. The few months of 1922 are added in order to include a rainy season with drier period of operation, for the cost of sun drying is always reflected in the weather.

TABLE NO. 1.—*Showing cost of producing copra by the sun drying method at Polo Coconut Plantation during 1921*

Month	Monthly harvest (Nuts)	Piculs (Copra)	Monthly expense	Average cost per picul	Average cost per 1,000 nuts	Number of nuts per picul
January	33,304	118.32	₱326.57	₱2.76	₱9.80	281
February	28,692	106.30	281.27	2.64	9.80	270
March	46,489	181.02	373.74	2.06	8.05	256
April	41,502	173.48	368.48	2.12	8.88	239
May	52,516	224.65	468.47	2.08	8.92	233
June	60,735	265.40	479.67	1.80	7.89	228
July	71,091	310.83	536.85	1.72	7.55	228
August	84,477	347.65	649.65	1.86	7.69	238
September	65,335	256.65	555.45	2.16	8.27	254
October	68,321	251.34	554.21	2.20	8.11	271
November	74,000	265.26	605.27	2.28	8.18	279
December	74,102	266.35	696.31	2.61	9.39	278
Total	700,564	2,767.25	5,895.94	26.19	102.53	3,055
Monthly average	58,213	230.60	492.32	2.19	8.54	254

TABLE NO. 2.—*For part of 1922 and 1923*

Month	Monthly harvest (Nuts)	Piculs (Copra)	Monthly expense	Average cost per picul	Average cost per 1,000 nuts	Number of nuts per picul
1922						
September	69,726	293.25	₱503.62	₱1.71	₱7.22	237
October	78,013	293.00	528.14	1.80	6.73	266
November	81,440	396.60	589.06	1.48	7.23	275
December	86,564	314.76	633.49	2.01	7.31	275
1923						
January	84,040	309.12	499.48	1.61	5.94	271
February	80,204	336.27	571.97	1.70	7.13	238
March	88,001	369.85	571.69	1.54	6.48	237
April	90,147	361.42	485.85	1.34	5.39	249
May	102,025	441.65	595.26	1.34	5.83	231
June	128,499	538.78	742.73	1.37	5.77	238
July	123,262	516.70	707.91	1.36	5.74	238
August	134,251	531.43	703.42	1.32	5.23	253
Total	1,146,172	4,702.83	7,132.62	18.58	76.00	3,008
Monthly average	95,514	391.90	594.38	1.55	6.33	250

TABLE NO. 3.—*Copra expenses for August, itemized*

	Total cost	Cost per picul	Cost per 1,000 nuts
Harvesting	₱164.26	₱0.309	₱1.225
Piling nuts in field	42.10	.079	.306
Splitting nuts, with axe	14.95	.028	.111
Extracting meat, in field	156.41	.294	1.165
Hauling meat to Headquarters	19.40	.036	.144
Drying, in sun and with dryer	145.92	.274	1.086
Sacking, for shipment	21.95	.041	.163
Hauling to beach, 5 kilometers	23.36	.044	.174
Loading on steamer	23.00	.043	.171
Sacks, 837 at ₱0.11	92.07	.173	.685
Total	703.42	1.321	5.230

ADDENDA

Since the blueprints of the dryer were completed, and the preceding article was written, the poultry netting on all of our dryer trays has been changed from the bottom to the top of the tray frames. This is more satisfactory since strength is added and there is no tendency for the wire netting to pull loose as when attached to the bottom.

The tray cross pieces, which are only 2″ or less in width, if made flush with the lower edge of tray frame, leave a tray depth of a full inch or more, which is quite sufficient.

The two tables given cover all copra producing costs beginning with the harvesting of the coconuts and ending with the loading of the completed product on to the steamer.

BOOK REVIEW

THE COCONUT PALM

Books about coconuts are so few that planters and students will welcome this new addition to coconut lore, written by H. C. Sampson, formerly director, Department of Agriculture, Madras, India.

The first part deals more exhaustively with the physiology and morphology of the coconut than any work that has come to our attention. The second part is devoted to plantation management. The author emphasizes the need of seed selection and cultivation as a means of increasing the yield, and close planting is condemned. With its many excellent features, one is rather surprised, though, to find in the book such statements as that the coconut is drought resistant, and that "on light soils in the tropics, it is doubtful whether a cover crop is ever of any use to a crop such as the coconut." Several long tables are presented to show the chemical composition of the different parts of the tree in different stages of development, and the amount of fertility removed from the soil. A third part is devoted to the different coconut products and the manufacture of copra in Malabar, the best in the market, is described at some length. Coconut diseases and insect pests, and their control, except for cursory remarks, are not discussed. Numerous excellent text figures and plates illustrate the bext. The reproduction of a bas-relief from the 9th century in a temple in Cambodia picturing the coconut palm is of particular interest. The colored plates are the best ever seen in any work about the coconut. Published by John Bale, Sons & Danielsson, Ltd., 83–91, Great Titchfield Street, Oxford Street, W. 1, London, England. Price, 33 shillings, post free.—P. J. W.

ERRATA

MAURITIUS HEMP, ("FURCROEA GIGANTEA"), WITH REFERENCE TO ITS INFERIORITY TO ABACA, MAGUEY, AND SISAL

By R. B. Espino and T. Novero

Philippine Agricultural Review, Vol. XVI, No. 2, 1923
Pages 108–119

The last paragraph on page 112 and continued on top of page 114 should read as follows:

After the elimination of Mauritius hemp with the use of *ammonia*, maguey may further be eliminated from the list or group with the application of *ammoniacal nickel oxide*. This solution colors all other fibers except maguey. This test eliminates this fiber. *Chlorine* water colors only the pineapple fiber. It gives pale ochraceous coloration. Abaca and sisal fibers are not stained. Cochineal tincture and potassium chromate color sisal light orange pink and pale lemon yellow, respectively, while the same reagents do not stain abaca fiber at all.

O

55

The Philippine Agricultural Review

Vol. XVII FIRST QUARTER, 1924 No. 1

A QUARTERLY PUBLICATION

ISSUED IN ENGLISH BY THE
BUREAU OF AGRICULTURE

The Government of the Philippine Islands
Department of Agriculture and Natural Resources

Subscription rates: ₱2 (Philippine currency) or $1 (U. S. currency) per annum in the Philippine Islands and the United States and territories.
$2 (U. S. currency) per annum in foreign countries

MANILA
BUREAU OF PRINTING
1924

(Entered at the Post Office at Manila as second-class matter)

THE PHILIPPINE
Agricultural Review

VOL. XVII FIRST QUARTER, 1924 No. 1

TABLE OF CONTENTS

	Page
1. On the Occurrence of Maize Rust in the Philippines, by Gaudencio M. Reyes	3
2. The Effects of Tobacco Dust and Lime on Barit, by Victorino Borja	10
3. Size of Seedling Tests with Special Reference to the Rate of Seeding and Relative Yields, by Juan P. Torres	13
4. The Effect of Sunlight on the Germination of Papaya Seeds, *Carica Papaya,* by Emilio K. Morada	21
5. The Seedless Breadfruits of the Pacific Archipelagoes, by P. J. Wester	24
6. Directions for Saving and Keeping Vegetable and Other Seeds, by P. J. Wester	40
7. The Preparation and Packing of Seeds and Scions of Trees and Shrubs in the Tropics, by P. J. Wester	46
8. Administrative Order No. 29—Regulations Governing the Importation and Exportation of Plant Materials to and from the Philippine Islands (Revised)	52
9. Administrative Order No. 30	59
10. Administrative Order No. 31	61
11. Administrative Order No. 32	63
12. Administrative Order No. 33	65
13. Administrative Order No. 34	67
14. Administrative Order No. 35	70
15. Administrative Order No. 36	72
16. Administrative Order No. 37	73
17. Administrative Order No. 38	75
18. Administrative Order No. 39	77
19. Current Notes	79

ILLUSTRATIONS

Facing page—

PLATE I. A portion of corn leaf infected with rust showing sori........ 8
II. A close view of a portion of corn leaf showing spots and much enlarged sori of *Puccinia sorghi* Schw., and the way the fungus spores rupture the epidermis........ 8
III. A photomicrograph of young and mature uredospores of *Puccinia sorghi* Schw., from corn showing on some of them the tiny spine-like projections and germ-pores 8
IV. A group of teleutospores and mesespores of *Puccinia sorghi* Schw., ... 8

TEXT FIGURE

FIG. 1. Opening and cover in receptacle for preserving seed........ 45

ON THE OCCURRENCE OF MAIZE RUST IN THE PHILIPPINES [1]

By Gaudencio M. Reyes

On June 26, 1923, Mrs. Mary Strong Clemens, who is making a collection of Philippine fungi, found a certain disease of corn, and some specimens were very kindly presented to the writer. The disease was collected at an altitude of 3,000 to 4,000 feet, near the gold mining camp of the Benguet Consolidated Mining Company at Antamok, Baguio, Mountain Province, Luzon.

Mrs. Clemens believed that the disease was a rust caused by *Puccinia sorghi* Schw. On consulting the List of Known Philippine Fungi by P. L. Ricker in the Philippine Journal of Science, Vol. 1, pp. 277–294, (Supplement) 1906; Lower Fungi of the Philippine Islands by C. F. Baker in Leaflets of Philippine Botany, Vol. 6, Art. 102, pp. 2065–2190, 1914, and Vol. 8, Art. 113, pp. 2417–2542, 1914; the Host Index of Philippine Fungi by Harry S. Yates, 1919 (unpublished); O. A. Reinking's Host Index of Diseases of Economic Plants in the Philippines, in the Philippine Agriculturist, Vol. 8, pp. 38–54, 1919; a Provisional List of the Parasitic Fungi of the Philippine Islands by Colin G. Welles in the Philippine Agricultural Review, Vol. 15, pp. 149–202, 1922; and, also, the accession register of Philippine fungi at the Bureau of Science, it was found that this disease had not hitherto been reported in the Philippines. Apparently this is the first collection of plants with this malady in the Philippines and no record exists of preserved material. Nothing could be said as to the origin of this disease as no authentic data is available. However, the writer learned that American sweet corn, introduced from California, is being grown in Trinidad, Baguio, from a letter of Mr. M. Manas y Cruz, Chief of the Plant Industry Division, Philippine Bureau of Agriculture.

[1] Contribution from Plant Pathology Laboratory.

[2] The writer is greatly indebted to former Director E. D. Merrill of the Philippine Bureau of Science for the use of the laboratory, and other facilities, especially the mycological and pathological herbarium. Thanks are also due to Dr. Nicanor G. Teodoro, Incharge of Plant Pathology Laboratory, Philippine Bureau of Agriculture, for suggestions and criticisms.

Sweet corn is the most susceptible species to corn rust according to the inoculation experiments conducted by Weber (13) at the University of Wisconsin.

This work was undertaken mainly as an attempt at identifying the fungus. Later, when opportunity permits, further observations will be made to determine definitely its distribution and seriousness in the Philippines. Studies will be made on some other phases also, such as etiology, inoculation work, the heterœcious character of the causal fungus, and control experiments.

DISTRIBUTION AND ECONOMIC IMPORTANCE

According to information received from Mrs. M. S. Clemens and from Mrs. Florence V. W. Kettenbach who made a survey and collection of the disease, the corn plants were more or less all infected and they did not mature well, probably because of the rust. It was also observed that the disease was particularly injurious on the lower leaves. In severe cases, Cook (3) reports that the leaves die prematurely and the value of corn as forage is thereby lessened. Duggar (4) states that it affects the leaves and leaf sheaths and may cause great damage to the growth of the inflorescence. Arthur (1) mentions that the corn rust is a persistent parasite and lives on the plant as long as it is alive. Although the rust on Philippine maize may not be considered of great economic significance at present because its occurrence appears to be local, it might become so when exceptionally favorable weather conditions obtain. So far, it is known to exist only in Baguio but further survey may reveal its presence in other localities.

DESCRIPTION OF THE DISEASE

The disease is characterized by the presence of small pustules, commonly elongated, and scattered profusely over the leaf (Plate I). Sometimes the pustules are found in the center of spots with clay colored centers and deep brownish drab borders, and a yellowish zone around. The center of the spot may also be of a grayish brown color with argus brown margin. Some spots coalesce and one or more of the pustules may be found in the center. The pustules may appear also on the green parts of the leaves without the slightest discoloration of the surrounding area (Plate II). They are more commonly produced on the upper surface of the leaf. They develop in the leaf tissue and elevate the epidermis which finally, when spores mature, bursts open, the fissure (Plate II) being in the direction of the leaf veins, and the powdery mass of spores come out.

The symptoms of rust on the Philippine maize greatly resemble the symptoms of preserved specimens of the same disease on corn contributed to the mycological herbarium of the Bureau of Science by the United States Department of Agriculture.

CAUSAL ORGANISM

Puccinia sorghi Schw., causing the corn rust, is said to have been reported as early as 1815, according to Stevens(12); and Duggar(4) believes it is indigenous to America. It is also known as *Puccinia maydis* Bereng., in Australia(6), and in India(2). *P. sorghi* is the first and only disease of maize that has ever been reported from Uganda according to Snowden (13). Saccardo(9) listed its synonyms as reported in the literature, and reported its occurrence on maize and sorghum in some countries of Southern Europe and in Somerset, East Africa. The rust on maize and sorghum are now considered to be different by Duggar(4), and by McAlpine(6) cited from Sydow's Monograph.

Careful microscopic study has shown that the pathogene on the Philippine maize rust agrees very closely with the description of the corn rust organism previously reported from the United States, Australia, and India.

Both uredospores (II) and teleutospores (III) were found but the latter were somewhat scarce. Under a hand lens the teleutosori appear darker in color than the uredosori. The uredosori are reddish brown while the teleutosori are much darker or almost black.

The uredosori are numerous, scattered or in groups, elliptic or oblong, raised, and occasionally confluent.

Uredospores (Plate III) are globose to ovoid, generally with four germ-pores and covered with short and tiny wart-like projections. The immautre uredospores are hyaline while the mature spores are buff-yellow to light orange-yellow. Uredospores from fresh material measure 24.05–35.52 x 23.69–30.71 microns based on 20 measurements. They germinate in water or in sugar solution in drop cultures.

The teleutosori are few, scattered, oblong, and sometimes confluent.

The teleutospores (Plate IV) are smooth, two-celled, chestnut-brown, especially the upper cell, which is generally a little larger than the lower cell, thickened at the apex (5.92–7.4 microns thick); apex rounded or somewhat papilliform; pedicels long, brownish, 5.5–7 microns wide, and thickened at the point of attachment with the spores. The teleutospores measure 33.30–42.18 x 20.72–26.64 microns. Mesospores are present (Plate IV).

According to a systematic arrangement of rust as briefly described by McAlpine(6), the teleutospores of *Puccinia* are two-celled, with horizontal septum, and have only one germ-pore in each cell. These distinguishing morphological characters are present in the teleutospores of the Philippine maize rust and the last characteristic was observed plainly when boiling some teleutospores in an equal proportion of glycerine and lactic acid on a slide for a few seconds over an alcohol flame, and then allowing the mount to cool down before examining under a microscope. Likewise two other formulæ were tried and they proved equally good for detecting both uredospores and teleutospores for germ-pores. One formula consisted of lactic acid, 1 part; phenol, 1 part; glycerine, 1 part; and distilled water, 1 part. The other formula used was a mixture of equal parts of lactic acid and phenol. These two different mixtures showed the germ-pores in teleutospores but not as distinctly as in uredospores.

The measurements made by Saccardo(9), McAlpine(6), and Butler(2) of uredospores and teleutospores vary somewhat but their measurements are very nearly approached by the writer's. The causal fungus is unquestionably *Puccinia sorghi* Schw.

It is worthy to remark that an imperfect fungus, *Darluca filum* (Biv.) Cast., was found associated frequently with the uredosori and occasionally with the teleutosori. The genus Darluca is mentioned by Stevens(11) as a fungus commonly found parasitic on rust fungi; and McAlpine(6) claims that *D. filum* attacks the mycelium, and presumably, he says, it prevents the formation of spores. It has been recorded upon 24 per cent of the *Puccinia* species(6).

The pycnidia or sporing bodies of *D. filum* are minute, black, gregarious, much darker or opaque around the ostiolum, globose, surface reticulate, and with very short or no neck.

The conidia are numerous, two-celled, with a transverse septum, not contricted at spetum, hyaline, fusiform, and measure from about 13.6–18.5 microns in length and about 3.7 microns in width. These morphological characters conform very closely with the preserved specimen of *Darluca filum* (Biv.) Cast., on *Puccinia magnusiana* Korn., on *Phrabmites communis* Trin., in the mycological herbarium of the Philippine Bureau of Science.

DISSEMINATION OF THE DISEASE

The disease may be disseminated by the wind, rain, insects as well as other animals, or by some other agents. It is also

probable that the disease is spread by seeds. Manns and Adams(5) proved by means of cultural and histological studies that parasitic fungi are carried in the kernel of corn. The four fungus parasites they found living inside the corn seed and inhibiting germination were: *Cephalosporium sacchari* Butler; *Fusarium moniliforme* Sheldon; *Gibberella saubinetii* (Mont.) Sacc.; and *Diplodia zeae* (Schw.) Lev. Whether or not seeds infected with these pathogenes will develop diseased plants when sown remains to be proved. In connection with Manns and Adams(5), studies, species of the genera *Aspergillus, Cladosporium, Penicillium, Alternaria, Helminthosporium, Rhizopus, Spicaria, Hormodendrum, Torula, Chaetonium, Colletotrichum,* and also some bacteria have been found occasionally associated internally with seed corn. Although rust caused by *Puccinia sorghi* Schw. was not included in their work, the writer is inclined to believe that it is also carried by seed. This remains to be proved, however.

HETERŒCISM

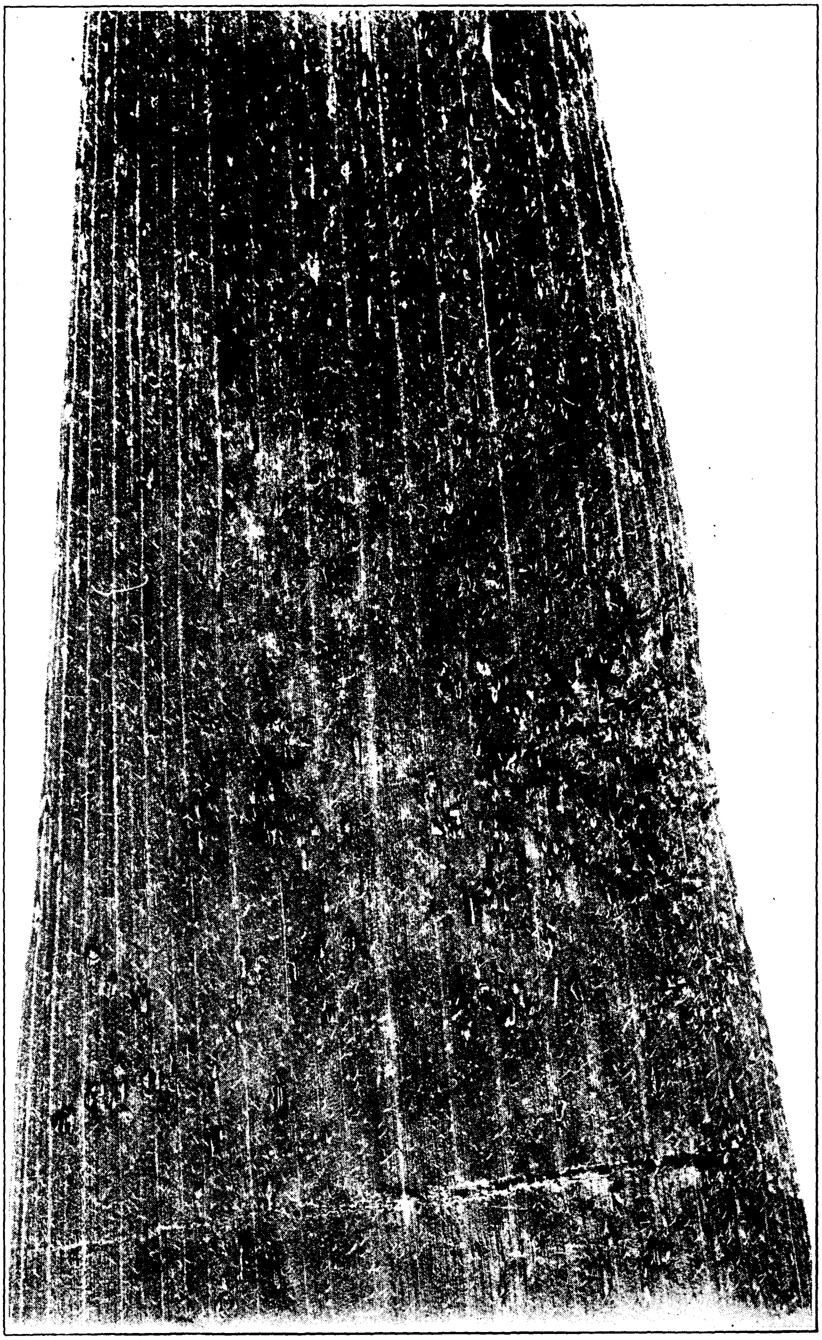
Corn rust has long been considered heterœcious. The æcidial stage has been found on several species of the genus Oxalis. According to Arthur(1), there are seven or eight records of the collection of æcidia on Oxalis and in each case it is believed that the æcidium was connected with *Puccinia sorghi* Schw. He succeeded in producing corn rust by inoculating with æcidiospores from æcidia of *Oxalis cymosa* Small. McAlpinne(6) believes that the Oxalis was infected from the teleutospores of *P. maydis.* The heterœcious character of maize rust was further established, according to Butler(2), by cross-inoculation of Oxalis leaves with sporidia produced from teleutospores of *Puccinia maydis* Bereng., and of maize leaves by using æcidiospores from Oxalis.

The other complimentary hosts mentioned in the literature and listed by Arthur(1) are: *Oxalis bowiei* Lindl., *O. Violacia* Linn., *O. stricta* Linn., and *O. corniculata* Linn. A closely related grass to maize, *Euchlaena mexicana* Schra., was found susceptible to the attack of *P. maydis* in India(2). In the Philippines, Merrill(7) reports that there are two species of *Oxalis,* a genus of the *Oxalidacea* (*Oxalis* or Balimbing Family), one of which, *Oxalis repens* Thunb., is very common throughout the Philipines and grows in places higher than where the corn rust was observed. It is frequently confused with *O. corniculata* Linn., he says. Its local names are "taiñgandaga," "susokoyili" (Tag.),

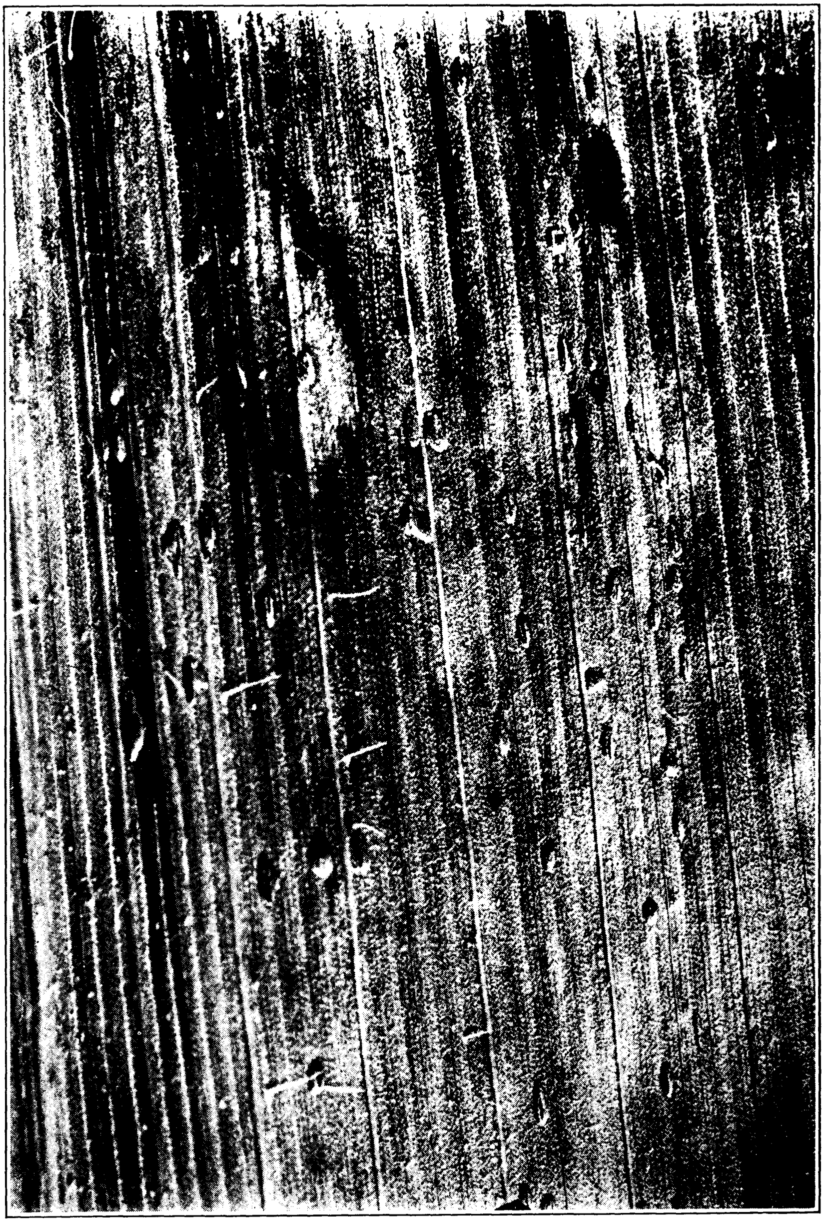
"marasiksik" (Ilk.), and "salamagi" (Bon.). It is quite safe to suppose that these plants might be liable also to the attack of corn rust. Some plants of *O. repens* were sprayed with an atomizer in the laboratory on August 17, 1923, with teleutospores diluded in sterile water from rusted corn leaves collected on the 26th of June, 1923, but after fourteen days there were no effects apparent. On September 26, 1923, an attempt was made to infect corn plants of a native yellow flint variety with both uredospores and teleutospores from the material collected in June, 1923, by cutting portions of the rusted leaves with ruptured sori and placing them on the upper surface of the leaves, supplying an extra moisture with the aid of moist cotton. After 24 days no evidence of infection was produced both in the infected and control plants. It seemed that the fungus has lost its vitality due to drying. However, inasmuch as no spores were allowed to germinate in a moist chamber as a check, the result obtained is rather unconclusive. Moreover, this experiment was carried out in the open air where the temperature (about 30° C.) was not probably favorable for the spores to germinate, and to cause an infection. In a reference which the writer came across, lately, Weber (13) reports thatirediniospores hardly germinated at 30° C., and they did not cause an infection on the corn plant at that temperature. Experiments in this direction will be conducted when fresh material is found. No life histories of rusts occurring in the Philippines have yet been studied.

CONTROL

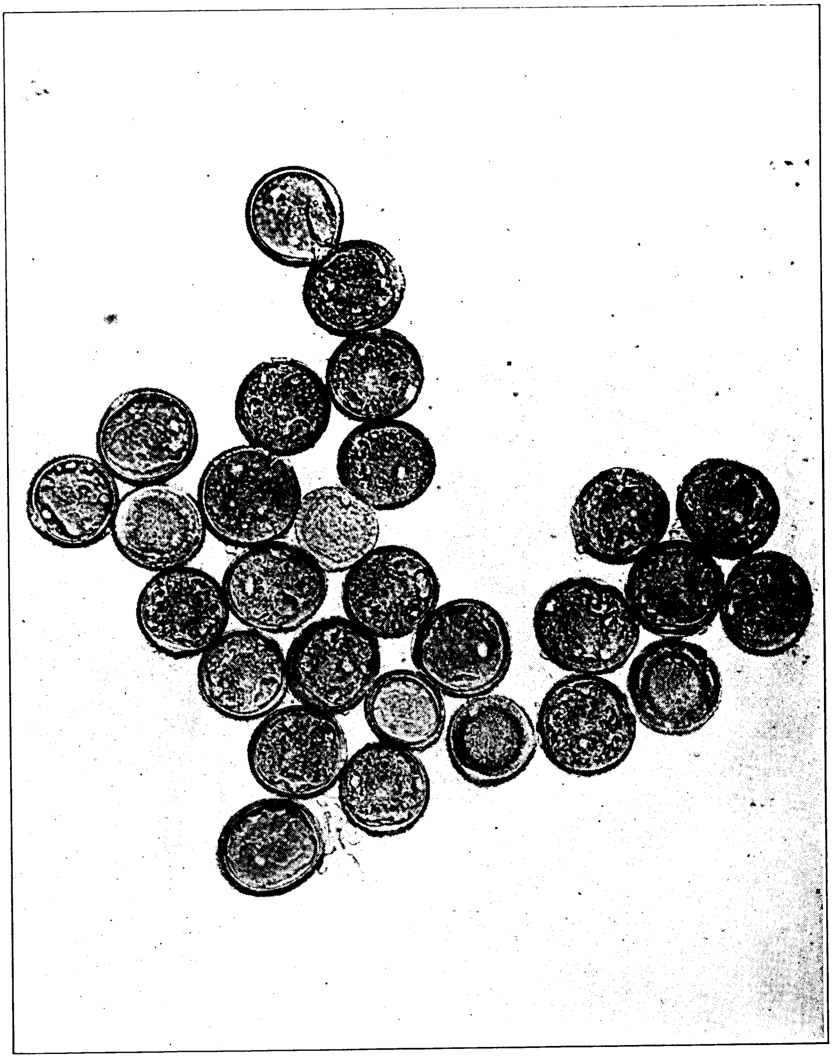
As far as the writer knows, no control measure for corn rust is recommended in the literature. Corn is not a permanent crop and therefore crop rotation could be easily practised if the disease became severe. Its life cycle should be studied and upon discovery of its intermediary host, a control measure similar to barberry eradication to mitigate loss from wheat rust may be urged. Variety resistance would also be a beneficial measure to be followed. Weber (13) found both in his observations in the field and in his artificial inoculation experiments that sweet corn ranks first in the degree of susceptibility to corn rust. The less susceptible species which resulted from his inoculation work are: *Zea everta* (pop corn), *Z tunicata* (pod), *Z. ramosa*, and *Z. indentata* (dent). Manns and Adams (5) found no successful method of seed disinfection for internal parasites of seed corn.



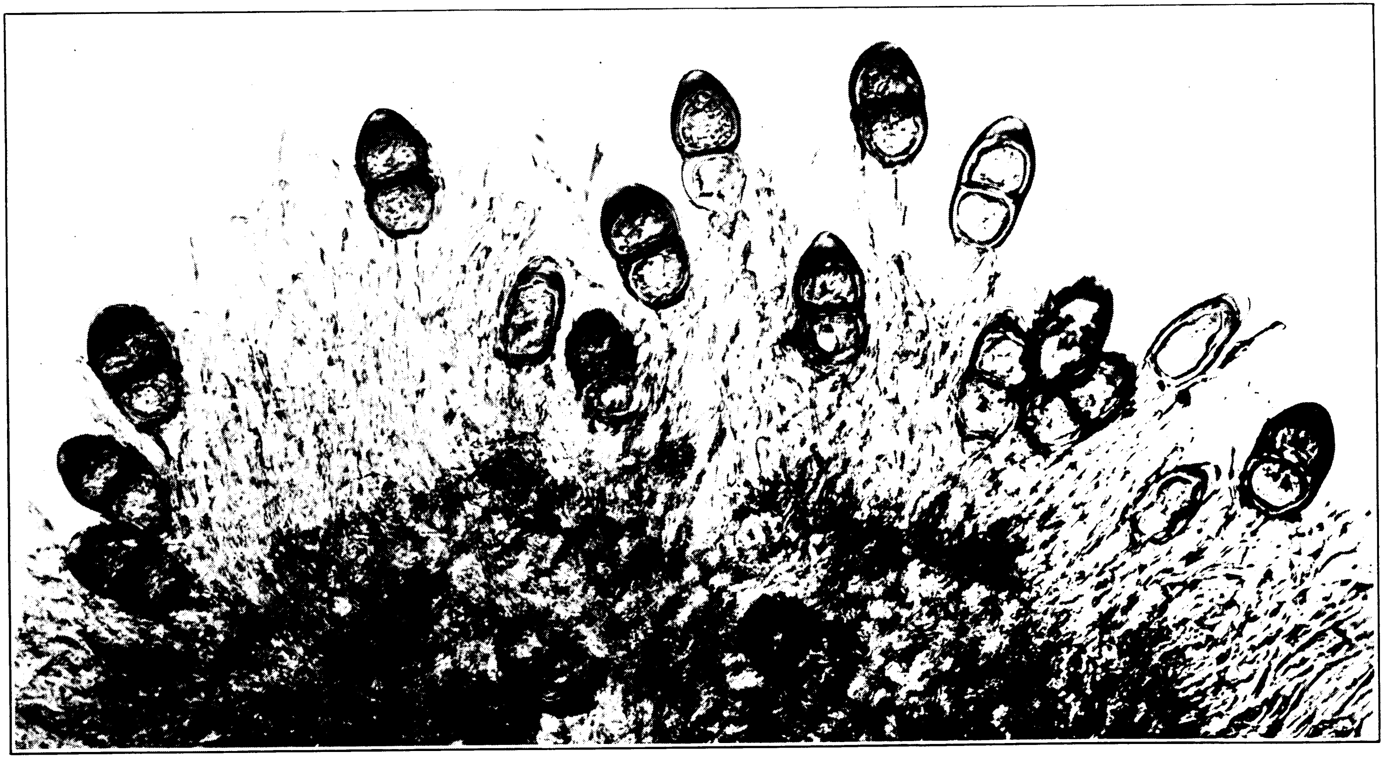
A portion of corn leaf infected with rust showing sori, × 2.



A close view of a portion of corn leaf showing spots and much enlarged sori of *Puccinia sorghi* Schw., and the way the fungus spores rupture the epidermis, × 7.



A photomicrograph of young and mature uredospores of *Puccinia sorghi* Schw., from corn showing on some of them the tiny spine-like projections and germ-pores. Taken from a water mount from three-months specimen. × 350.



A group of teleutospores and mesospores of *Puccinia sorghi* Schw. Note the long pedicels, × 350.

LITERATURE CITED

1. ARTHUR, J. C. The æcidium of maize rust. The Botanical Gazette 38: 64–67. 1904.
2. BUTLER, E. J. Fungi and disease in plants. 547 p., *206 fig.* Calcutta. 1918.
3. COOK, M. T. The diseases of tropical plants. 317 p., *85 fig.* London. 1913.
4. DUGGAR, B. M. Fungous diseases of plants. 508 p., *240 fig.* Boston. 1909.
5. MANNS, T. F. and ADAMS, J. F. Parasitic fungi internal of seed corn. Journal of Agricultural Research *23:* 495–524, pl. 1–13. 1923.
6. MCALPINE, D. The rust of Australia. 349 p., *55 pl.* (including 366 fig.). Melbourne. 1906.
7. MERRILL, E. D. A Flora of Manila. 490 p., Manila. 1912.
8. RIDGWAY, ROBERT. Color standards and color nomenclature. *43 p. 53 col. pl. and 1115 named col.* Washington. 1912.
9. SACCARDO, P. A. Sylloge fungorum 7: 659–660. 1898.
10. SNOWDEN, J. D. Report of the Government Botanist for the period of 1st of April to 31st of December, 1920. Ann. Rept. Dept. Agric. Uganda for nine months ending December 31, 1920, pp. 43–46, 1921.
11. STEVENS, F. L. The fungi which cause plant disease. 754 p., *449 fig.* New York. 1913.
12. STEVENS, F. L. Diseases of economic plants. 507 p., *238 fig.* New York. 1922.
13. WEBER, GEORGE F. Studies on corn rust. Phytopathology 12: 89–97, Figs. 1–3, 1922.

THE EFFECTS OF TOBACCO DUST AND LIME ON BARIT[1]

By VICTORINO BORJA, *Agronomist, Alabang Rice Station*

In an experiment conducted at the Alabang Rice Station to find out the proportions in which tobacco dust and lime may be combined and applied to barit, the amount of lime used was based on the experience with Alabang soils,[2] where applications of 200 to 500 kilos to the hectare have given good results; and also on the requirement of the Internal Revenue Bureau that at least 20 per cent of lime be added to the tobacco dust.

Three adjacent paddies ("checks") having about the same kind of soil and irrigation facilities, were selected. Throughout the period of experimentation a uniform depth of water was kept in all.

The application of the mixtures were made on May 8, 1920, when the grass had just been cut and had not yet formed whole leaves.

Each paddy was divided into three sections. In the first two duplicate paddies, sections marked I–a and II–a were used as control; sections I–b and II–b were treated with a mixture containing 90 per cent tobacco dust and 10 per cent commercial lime, applied at the rate of 2 metric tons per hectare; and sections I–c and II–c were treated with a mixture containing 85 per cent tobacco dust and 15 per cent lime, applied at the same rate. Section III–a, in the third paddy, served as control. Section III–b was given a mixture containing 95 per cent tobacco dust and 5 per cent lime, at 2 metric tons per hectare; and section III–c, a mixture containing 80 per cent tobacco dust and 20 per cent lime, at the same rate.

Arrangement of sections in three paddies

I-a	II-a	III-a
I-b	II-b	III-b
I-c	II-c	III-c

[1] Barit, *Leersia hexandra* Swart.

[2] Alabang soils according to an analysis contain 0.137 per cent nitrogen, 0.1 per cent phosphorus anhydride, 0.045 per cent potash, 0.263 per cent lime, and 0.83 per cent humus; acid reaction.

Observations made on the the first week following the treatment showed a distinct yellowing of the plants in all sections receiving less than 15 per cent lime in the mixture. This discoloration was particularly pronounced in section III–b where the mixture applied contained only 5 per cent lime.

In the second week, however, the plants of all the treated sections began to grow vigorously, and their normal color reappeared.

The crops reached full maturity July 5, 1920. The yields of grass were as follows:

TABLE I.—*Showing the yields of the duplicate paddies. Mixtures applied at the rate of 2 metric tons per hectare*

Section No.	Mixture containing	Area of section	Yield of section	Estimated yield per hectare	Estimated average yield per hectare
		Sq. m.	*Kilos*	*Kilos*	*Kilos*
I–a	None	111.94	176.4	15,758.4	15,381.1
II–a	do	117.17	175.8	15,003.8	
I–b	Tob. dust, 90 per cent; lime, 10 per cent	92.38	164.0	17,752.8	17,788.5
II–b	do	107.27	191.2	17,824.2	
I–c	Tob. dust, 85 per cent; lime, 15 per cent	116.37	216.37	18,578.6	18,185.0
II–c	do	124.78	222.0	17,791.3	
III–a	None	116.30	182.5	15,692.2	....
III–b	Tob. dust, 95 per cent; lime, 5 per cent	112.46	213.0	18,940.0	....
III–c	Tob. dust, 80 per cent; lime, 20 per cent	113.96	297.4	26,096.9	....

In comparing the average yields per hectare of sections I–a and II–a (Table I), with those of sections I–b and II–b, and, again with those of I–c and II–c, it will be seen at once that there was an increase over the control of 2,407.4 kilos (15.6 per cent) and 2,803.9 kilos (18.2 per cent) of the sections treated with the mixture containing 90 per cent tobacco dust and 10 per cent lime, and with the mixture containing 85 per cent tobacco dust and 15 per cent lime, respectively. The last increase would have been greater but for the fact that the stand of the grass in section II–c was thin, which must have brought the normal average down by something like 5 per cent.

The effects of treatment in sections III–a, III–b, and III–c were greater proportionally, as the figures will show. While the yield of the control section III–b was practically the same as for the corresponding sections I–a and II–a the gain obtained in section III–b was 3,247.8 kilos (20.8 per cent), and 1,040.7 kilos (66.3 per cent) in section III–c.

The yields thus increased with the increased proportions of lime in the mixtures. Just how much of the benefit was due to the tobacco dust could not be ascertained by this experiment. It appears though that there was none, except for the part it might have played as an insecticide with reference to the grass just as lime might have done with reference to the tobacco dust.

To summarize the results:

(1) Where lime in the mixture was less than 15 per cent the tobacco dust was at first inimical to the growth of barit. But the effect was only temporary and could be neutralized with the use of 20 per cent lime in the mixture.

(2) The increase of yields was due chiefly, if not solely, to the addition of lime, it being proportional to the amounts of lime contained in the mixtures.

(3) Everything considered, the mixture which gave the best results was the one containing 80 per cent tobacco dust and 20 per cent lime. The minimum limit to which lime might enter in combination with tobacco dust should be 15 per cent. With less there might be danger of the irritating effects of tobacco dust.

(4) Lime alone may be applied to barit to advantage.

SIZE OF SEEDLING TESTS WITH SPECIAL REFERENCE TO THE RATE OF SEEDING AND RELATIVE YIELDS

By JUAN P. TORRES, *Assistant in Agronomy, Alabang Rice Station* [1]

INTRODUCTION

There is a difference of opinion among our rice growers relative to the method of transplanting large or vigorous and weak or under-sized seedlings. Many of them have not realized yet the advantages of one type of seedlings over the other and they believe that it makes no difference at all whether they should transplant large or small seedlings. So, they sow their seeds rather too thickly. Consequently, they produce small and less vigorous seedlings. A few farmers, however, seem to know by experience the fact that weak plants give comparatively smaller yield than vigorous ones.

Borja [2] in 1918, experimenting with big as against ordinary sized seedlings of the variety Pauni, No. 663, found that the former gave a 96 per cent stand and a yield of 2,065.6 kilograms to the hectare, as against the latter, 83 per cent stand and 1,725 kilograms of yield obtained from the latter.

Nowadays, the rate of seeding generally used is one cavan (43.6 kilograms) seeds to 333 square meters or one kilogram to approximately 8 square meters of seedbed. At this rate however the seeds must have 100 per cent germination or close to it, although 75 per cent germination may be enough.

The object of this article is to furnish a guide as to the proper rate of seeding and to determine the superiorities of the large seedlings over the small ones of the same age together with the effect of the rate of seeding upon the yields of transplanted rice.

This experiment was begun in July, 1922, and was performed in a portion of field A of the Alabang Rice Station, Alabang, Rizal. This portion of the field, which has a heavy clay soil, had just been used for seed-bed.

METHODS OF EXPERIMENTS AND MATERIALS USED

Ten plots, of two square meters each, were prepared in a paddy in field A in two rows of five plots each, and serially designated plots A, B, C, D, and E. They were raised about one

[1] Mr. Torres is now a government student in the United States.

[2] 1918 Annual Report of Alabang Rice Station.

centimeter above the surface of the rest of the paddy, the tops were leveled off. The varieties Ramai, No. 1225, and Tadung, No. 1258, were used. Samples of seeds were first tested for germination, and the quantities of seeds corresponding to the rate of seeding shown in Table I, were weighed out. On July 8, the seeds were placed under water for about eighteen hours to start germination and on the following day scattered uniformly in each of the plots.

Ramai alone was used for the determination of the number of each of the two kinds of seedlings (large and small) from each rate of seeding. Thirty days from sowing, the seedlings were carefully pulled up and thoroughly cleaned from soil, and the excess water removed. Five bundles of 200 grams each were weighed from each lot and counted for the number of large seedlings only considering the width of its base. See Table I. Those of two millimeters or less (flat-crosswise diameter) were considered small seedlings and those wider were counted as large.

Two thousand sound seedlings each of the large and small kinds were selected from each variety. Large seedlings were taken from their plots A and the small from plots E. The seedlings were transplanted on August 10, 1922, one plant to the hill and the hills were set 20 centimeters apart each way. This spacing was maintained by means of small chains of twenty-centimeter links. Alternated with every two rows of large seedlings were two rows of the other kind. One row consisted of one hundred plants. Fillers of the same varieties were planted next to the outside rows of the tests.

When the plants reached maturity each was tied up separately and cut down as close to the ground as possible. Then individual plant records as to length and number of culms and the weight of grains were taken.

TABLE I.—*Number and percentages of large and small sized seedlings as affected by the rate of seeding*

Rate of seeding	One cavan to—									
	A -200 sq. m.		B–170 sq. m.		C–140 sq. m.		D–120 sq. m.		E–60 sq. m.	
Bundles	*Large*	*Small*	*Large*	*Small*	*Large*	*Small*	*Large*	*Small*	*Large*	*Small*
First	282	75	238	194	106	410	138	450	62	412
Second	276	68	189	162	177	207	128	317	100	460
Third	344	45	356	174	141	237	83	438	89	466
Fourth	245	39	236	156	138	397	145	422	49	592
Fifth	224	75	196	55	124	203	74	519	94	394
Total	1,271	302	1,115	745	686	1,444	568	2,146	394	2,324
Percentages	81	19	60	40	32	68	21	79	15	85

DESCRIPTION AND DISCUSSION OF RESULTS

One cavan to two hundred square meters, had produced 81 per cent of large seedlings. Others gave percentages going down invariably in proportion to the area. (See table I.) Referring to the percentages of large seedlings in A, B, C, and D, it may be seen that by decreasing the area by ten square meters the percentages of large seedlings will decrease on the average of 7.5 per cent. Theoretically, it would seem that by increasing the area to 240 square meters we should get approximately 100 per cent large seedlings. But the presence of a number of inferior seeds in any seed samples will naturally make the percentage less.

Referring to the results recently obtained it may be stated that the maximum number of vigorous seedlings will be obtained by sowing seeds having 91 to 100 per cent germination at the rate of one cavan to 325 square meters of seedbed. Hence, the table for the proper rate of seeding furnished herewith may be followed.

TABLE II.—*Proper rate of seedling*

Germination	Area in square meters for—		
	1 cavan	1 ganta	1 kilogram
75 to 80	225	9	5
81 to 90	275	11	7
91 to 100	325	13	8

The seeds should first be tested for their germination, and those of less than 75 per cent discarded if possible.

Stand.—The original number of each type of seedling was as stated above, two thousand. It is interesting to note that with two varieties used, the small seedlings were less resistant to existing conditions than the large type. The average stand for the large was 87.13 and only 59.65 per cent for the small.

TABLE III.—*Number of plants harvested and percentages of stand of different types of seedlings*

Varieties	Number harvested		Percentages stand	
	Large	Small	Large	Small
Ramai	1,794	1,313	88.6	64.4
Tadung	1,766	1,157	85.7	54.9
Averages	1,780	1,235	87.13	59.65

Length of culm.—The length of culm was not practically affected by the size of the transplanted seedlings. This is very

well illustrated by the results obtained from the variety Tadung in which the model type was 100 centimeters and the average or mean length was 91 centimeters of both large and small types of seedlings. The results from Ramai do not seem to agree for the model types were 115 and 105 and the average lengths were 111.2 and 102.9 centimeters for large and small, respectively. The difference of nodes was 10 centimeters and the means 8.3 centimeters in favor of the large seedlings. For other details, see Table IV.

Number of culms per plant.—Large seedlings produced bigger stools or a greater number of culms to the plant. (Observe Table V.) The difference between large and small seedlings is obvious in their nodes and averages. Ramai having 5 and 3 for model types in the number of culms, gave the averages 5.01 and 3.47 culms per plant. Tadung, the nodes of which were 4 and 3, gave the averages 5.05 and 3.73 culms to the plant.

Weight of grain.—The large type of seedlings gave higher average yields of grain per plant, and greater production per hectare than the small seedlings. (Note tables VI and VII.) Ramai gave 14.4 grams average yield per plant of the large type as against 9.11 grams of the other kind while the nodes were 12 and 8 grams, respectively. Tadung with 8 and 6 grams as model types gave the average yields, 13.05 grams and 8.23 grams for large and small, respectively. Comparing the total production of one type of seedlings with the other, the small type produced only 46 per cent of the large type for the variety Ramai and 44 per cent correspondingly for Tadung. Therefore, the average of the total production of small seedlings of the two varieties was 45 per cent of the average of the total production of large type of seedlings of these varieties.

Now considering the influence of the rate of seeding upon the yields and basing upon results obtained from Ramai on tables I and VII, evidently the yields per hectare are invariably decreasing in inverse ratio to the area of the seed-beds for a given quantity of seeds. In other words, thick seeding tends to produce weak seedlings, hence small crops. (See table VIII.) The rate, one cavan seed to 200 square meters which produced 81 per cent large seedlings and 19 per cent small ones, will give a yield of 2,569 kilograms to the hectare, whereas the third rate having 140 square meters for one cavan of seed will only produce 1,904 kilograms of rough rice per hectare. Thus, the yield is decreased by 25.8 per cent or 6.65 kilograms by the use of the latter.

SUMMARY OF CONCLUSIONS

The results obtained so far show conclusively that the rate of seeding directly influences the size of seedlings for transplanting, hence, also the yields. Moreover, large seedlings make a better stand in the proportion of 87.13 per cent to 59.65 per cent. The small seedlings produced less culms and of less average weight of grain per plant. In addition to this, the total production of small seedlings was only 45 per cent of what the larger yielded. On the other hand, the length of culm was only slightly affected, if at all, by the size of the transplanted seedlings.

TABLE IV.—*Frequency distribution for the height of plants*

Height (cm.)	Ramai		Tadung	
	Large	Small	Large	Small
50	0	0	0	1
51	0	0	0	0
52	0	0	0	0
53	0	0	0	0
54	0	0	0	1
55	0	0	1	0
56	0	0	0	0
57	0	0	0	1
58	0	0	0	0
59	0	0	0	1
60	0	3	1	4
61	0	0	1	2
62	0	1	1	1
63	0	0	1	5
64	0	1	1	3
65	0	2	4	6
66	1	0	2	5
67	0	1	3	8
68	0	2	1	3
69	1	1	1	2
70	1	4	8	9
71	0	3	4	10
72	2	5	3	4
73	0	3	7	6
74	1	4	5	11
75	2	5	16	11
76	1	8	14	14
77	1	7	14	14
78	3	10	5	15
79	2	5	6	13
80	7	15	36	30
81	2	7	18	14
82	6	11	26	15
83	2	14	24	25
84	3	19	31	30
85	9	20	46	45
86	10	14	33	35
87	9	25	36	53
88	13	12	30	39
89	12	18	26	22
90	21	31	71	51
91	20	17	78	42
92	19	32	49	37
93	17	21	55	41
94	28	30	79	52
95	25	38	71	49
96	32	25	49	43
97	28	28	48	25
98	37	31	52	33
99	21	23	55	37
100	50	51	131	64
101	36	38	48	26
102	39	34	47	17
103	32	33	37	24
104	60	33	56	19

TABLE IV.—*Frequency distribution for the height of plants*—Continued

Height (cm.)	Ramai		Tadung	
	Large	Small	Large	Small
105	52	59	65	20
106	47	26	37	9
107	42	38	40	12
108	45	29	28	11
109	52	22	15	8
110	67	56	46	21
111	46	32	25	13
112	51	33	18	6
113	40	32	13	7
114	45	23	21	3
115	73	35	23	10
116	49	24	12	5
117	47	27	12	2
118	59	20	11	2
119	51	12	6	5
120	71	30	7	7
121	40	19	5	1
122	36	14	8	1
123	35	13	3	1
124	38	11	4	1
125	37	15	2	0
126	23	13	4	1
127	24	11	3	0
128	26	5	2	1
129	24	6	2	1
130	32	7	1	1
131	13	3	3	0
132	12	0	0	0
133	9	2	1	0
134	10	2	2	0
135	10	0	2	0
136	3	0	1	0
137	7	0	0	0
138	5	2	0	0
139	4	0	0	0
140	7	1	2	0
141	2	1	0	0
142	2	0	1	0
143	2	0	0	0
144	0	0	0	0
145	2	0	0	0
Totals	1,794	1,313	1,766	1,157
Averages	111.2	102.9	91.01	91.08

TABLE V.—*Frequency distribution for the number of culms*

Number of culms	Ramai		Tadung	
	Large	Small	Large	Small
1	19	63	48	65
2	114	278	116	210
3	257	397	234	289
4	375	272	344	281
5	382	163	343	139
6	297	82	293	102
7	168	28	172	42
8	93	21	126	20
9	54	5	48	5
10	19	1	26	3
11	9	2	9	0
12	2	1	2	1
13	3	0	2	0
14	0	0	2	0
15	1	0	0	0
16	1	0	1	0
Totals	1,794	1,313	1,766	1,157
Averages	5.01	3.47	5.05	3.73

TABLE VI.—*Frequency distribution for the weight of grain produced per plant*

Weight of grains (grams)	Ramai		Tadung	
	Large	Small	Large	Small
1	3	21	11	29
2	14	45	29	58
3	16	63	46	68
4	37	107	67	119
5	42	90	54	79
6	93	140	93	123
7	63	65	59	74
8	116	142	139	111
9	87	107	108	75
10	94	85	134	70
11	108	82	67	38
12	121	75	128	71
13	120	48	74	36
14	80	44	91	33
15	100	33	97	28
16	91	32	86	21
17	60	20	41	13
18	87	24	86	15
19	65	13	43	6
20	60	10	46	12
21	57	9	38	7
22	38	4	18	0
23	40	4	30	1
24	27	4	31	5
25	26	5	14	0
26	20	2	20	0
27	12	5	15	1
28	23	3	13	3
29	12	1	6	1
30	11	1	4	0
31	8	1	6	1
32	8	2	6	0
33	6	0	2	0
34	4	0	2	0
35	5	0	2	1
36	8	0	3	0
37	0	0	1	0
38	2	0	0	0
39	0	0	0	0
40	0	0	0	0
41	1	0	1	0
42	0	0	1	0
43	1	0	0	0
44	0	0	0	0
45	0	0	0	0
46	0	0	0	0
47	1	0	0	0
48	0	0	0	0
49	1	0	0	0
50	0	0	0	0
51	2	0	0	0
52	0	0	0	0
53	0	0	1	0
Totals	1,770	1,287	1,713	1,099
Averages	14.4	9.11	13.05	8.23

TABLE VII.—*Comparative yields of large and small sized seedlings*

Varieties	Actual yields in kilograms		Yields per hectare in kilograms	
	Large	Small	Large	Small
Ramai	25.488	11.705	3,186	1,463
Tadung	22.354	9.036	2,794	1,130

TABLE VIII.—*Theoretical yields as influenced by the rate of seedlings, based from Ramai*

Rate of seeding 1 cavan (sq. meters)	Percentages		Yields per hectare in kilograms	Decrease yields in kilograms
	Large	Small		
200	81	19	2,569	...
170	60	40	2,497	72
140	32	68	1,904	593
120	21	79	1,715	189
60	15	85	1,584	131

ACKNOWLEDGEMENT

Due thanks are given to Messrs. Teodoro Corpus and Jose O. Blanco by the author for their help in compiling data and also to Mr. Victorino Borja, Agronomist, for his valuable suggestions and criticisms in the preparation of this manuscript.

THE EFFECT OF SUNLIGHT ON THE GERMINATION OF PAPAYA SEEDS, *CARICA PAPAYA*

By EMILIO K. MORADA, *Assistant in Horticulture*

It is a well-known fact that sunlight plays an important rôle in the germination of seeds. How much sunlight is required to give a satisfactory result for an individual variety of seeds is the chief aim of this experiment. The absence of sunlight will either hinder or destroy more or less the germinative power of the seed, because it deprives the seed of the stimulant which hastens its germination. The quantity of light necessary for the germination of seeds depends on the intensity of the sunlight, the size and the characteristics of the covering of the seeds in question. The smaller the seeds the less light is needed. The harder and the thicker the covering is, the more light is required.

To germinate the papaya seeds successfully a proper amount of light is required. Many people fail to germinate papaya seeds because they do not provide the necessary amount of light required for the best germination. They often place them either under total shade or sunlight and as a result the seeds will give a low germination or none at all. In the first case, the seeds will be dormant for a long time; while in the second case the germinating power is lost due to the excessive amount of sunlight. Therefore, in order to avoid the many failures in germinating papaya seeds, this experiment on the relation of sunlight on its germination was conducted at the Lamao Experiment Station, Lamao, Bataan.

PLAN OF THE EXPERIMENT

A good sized ripe fruit of Hawaiian papaya was obtained. The seeds were taken and washed thoroughly by removing the outer covering and the watery substance adhering to the seeds. Then they were dried at room temperature for a day. The seeds were then divided equally into five portions of 300 seeds each. The seeds in each portion were planted in separate earthen pots of about 22.5 cms. in diameter, filled with soil, leaving only about 3 cms. unfilled. The seeds were broadcasted on the

surface and covered with a thin layer of soil. Each pot was subjected to the following conditions:

1. Entire shade,—the whole day without receiving heat of the sun.
2. Entire shade,—the pot was placed in the shade near the edge of the building the whole day so that it received more light than No. 1.
3. Half day sunshine from 7 a. m. to 11.30 a. m.
4. Partial shade,—under the nursery shed.
5. Entirely exposed in the sunlight the whole day.

The pots under all the conditions received the same treatment as to watering, mixture of soils, drainage, etc.

The dates and per cent of germination were recorded.

After a month the pots under the first and second conditions were placed under the third condition to determine whether the seeds which did not germinate would still grow.

A second set of similar experiment has been undertaken to verify the first results.

Tables I and II indicate the results of the experiment.

TABLE I

Conditions	Date		Number of seeds germinated	Percentage of germination	Remarks
	Planted	Germinated			
1.........	April 5...	....	0	0	Subjected to condition 3 on May 17. Fifteen seeds germinated on May 23,—5 per cent.
2.........	April 5...	April 19..	44	14.66	
3.........	April 5...	April 15..	107	35.66	
4.........	April 5...	April 15..	63	21.0	
5.........	April 5...	....	0	0	

TABLE II

Conditions	Date		Number of seeds germinated	Percentage of germination	Remarks
	Planted	Germinated			
1.........	May 17..	June 28..	3	1.00	Subjected to condition 3 on July 2. Twenty-five seeds germinated on July 10,—8.33 per cent.
2.........	May 17..	June 28..	8	2.66	Subjected to condition 3 on July 2. Thirty-two seeds germinated on July 8,—10.66 per cent.
3.........	May 17..	May 28..	80	26.66	
4.........	May 17..	May 28..	41	13.66	
5.........	May 17..	....	0	0	

DISCUSSION OF RESULT

It will be noticed in table I that the seeds germinated under conditions 2, 3, and 4, while the seeds did not germinate under conditions 1 and 5. Under condition 3 the highest percentage of germination was obtained, which is 35.66 per cent; under condition 4, is 31.0 per cent; and under condition 2, 14.66 per

cent. The seeds under condition 5 did not germinate because of the excessive sunlight which destroyed the vitality of the seeds. No germination was obtained under condition No. 1 but in subjecting the seeds to condition 3, 5 per cent germination was obtained. This shows that the seeds are dormant in a shady place, and no germination could be obtained unless a certain amount of sunlight was given them. It takes also longer time for the seeds under condition 2 to germinate than those under conditions 3 and 4.

In the experiment shown in Table II, the same results have been obtained, comparatively speaking. Under condition 3, 26.66 per cent germination was obtained, the highest percentage of germination; under condition 4, 13.66 per cent; under condition 2, 2.66 per cent; and under condition 1, 1.0 per cent. The seeds under condition 5 did not germinate. In subjecting those under conditions 1 and 2 to condition 3, they gave a germination of 8.33 per cent and 10.66 per cent, respectively. The seeds under conditions 3 and 4 germinated in 11 days while those under conditions 1 and 2 previous to other treatments germinated in 42 days. On putting under condition 3, the seeds under condition 2 germinated in 6 days while those under condition 1 germinated in 8 days. In all cases, there was a low percentage of germination.

From the above results, it is therefore self-evident that a certain amount of sunlight is necessary in the germination of papaya seeds, and that its absence retards the germination of the seeds, and may destroy the germinative power of same also. Too much sunlight as under condition 5 destroys the vitality of the seeds while too little sunlight retards the germination. One-half day sunshine from 7 a. m. to 11.30 a. m. and one-half sunshine under partial shade is the amount of sunlight necessary for the germination of papaya seeds.

CONCLUSION

1. Seeds under total shade during the whole day will not germinate but on exposing to sunlight for one-half day, they will.

2. One-half day sunshine from 7 a. m. to 11.30 a. m. and partial shade (under nursery shed) are the best condition under which seed germinate.

3. Too much sunlight is detrimental to the seeds. It destroys the vitality of the seeds. On the other hand, the absence of sunlight will retard the germination. The seeds will be in a dormant stage.

THE SEEDLESS BREADFRUITS OF THE PACIFIC ARCHIPELAGOES

By P. J. Wester

INTRODUCTION

"In the reign of a certain king when the people ate *araea*, red earth, a husband and wife had an only son whom they tenderly loved. The youth was weak and delicate, and one day the husband said to the wife: I compassionate our son, he is unable to eat the red earth. I will die and become food for him. The wife said: How will you become food? He answered: I will pray to my god, he has power and he will enable me to do it. Accordingly he repaired to the family *marae* and presented his petition to the deity. A favorable answer was given to his prayer, and in the evening he called his wife to him and said: I am about to die; when I am dead take my body, separate it, plant my head in one place, my heart and stomach in another, etc., and then go into the house and wait. When you shall hear first a sound like that of a leaf, then of a flower, afterwards of an unripe fruit, and subsequently of ripe, round fruit falling to the ground, know that it is I who am become food for our son. He died soon after. His wife obeyed his injunction, planting the stomach near the house as directed. After a while she heard a leaf fall, then the large scales of the flower, then a small unripe fruit, afterwards one fullgrown and ripe. By then it was daylight. She awoke her son, took him out, and they beheld a large, handsome tree with broad, shining leaves and loaded with breadfruit."

According to tradition in Tahiti this is the origin of the breadfruit.

While the breadfruit (always speaking of the seedless form) probably originated in some of the islands east of Java, and thence was carried eastward by the Polynesians in their early migrations, it was first seen in the Marquesas Islands in 1595 by Europeans. Quiros gave the earliest account of the breadfruit in a letter to Morga, published in 1609, where he says that "there is no fruit superior to it." Rumphius, the first

writer to mention it from the Malay Archipelago, says that it was unknown in the western part and found only in the east and southeast (of the Dutch East Indies). Even yet the breadfruit is of but little importance in that country, and Heyne records only two varieties (in Madura).

Since Morga, who was made acquainted with the breadfruit from the Marquesas by Quiros, does not mention it from the Philippines in his "Sucesos," it may be assumed that it was still unknown here at the beginning of the seventeenth century. As the *Dugdug Marianorum* is obviously a species from Guam included by Camello in his descriptions of Philippine fruits published in Ray's "Historia Plantarum," so there is nothing to indicate that his description of *Rhymay Marianorum* is not also that of a species from Guam, at best recently thence introduced in the Philippines, where it is now known as *Rima* in Luzon. In Guam as *Lemae.* Blanco's statement that the seedless breadfruit occurs spontaneously in Leyte may safely be discounted. Moro tradition has it that the Marang, *Artocarpus odoratissima,* mango, durian, and mangosteen were introduced by them from the west, but the breadfruit was unknown to the Moros until a few years ago when it was brought from Manila to Jolo and Zamboanga.

The famous Captain Cook on his return to England said about the breadfruit: "Of the many vegetables that have been mentioned already as serving them (the Tahitians) for food the principal is the breadfruit, to procure which costs them no more trouble or labor but climbing a tree. The tree which produces it does not indeed shoot up spontaneously, but if a man plants ten of them in his lifetime, which he may do in an hour, he will as completely fulfill his duty to his own and future generations as the natives of our less temperate climate can do by plowing in the cold of the winter and reaping in the summer heat as often as these seasons return; even if, after he has procured bread for his present household, he should convert a surplus into money and lay it up for his children."

It was glowing accounts like these which finally persuaded the British Government to dispatch the illfated ship *Bounty,* in command of Captain Bligh, to Tahiti, for a shipload of breadfruit trees for introduction into the British colonies in the West Indies.

The Swedish botanist Solander, who accompanied Captain Cook, made the first variety list of the seedless breadfruits. His list, which has never been published, enumerated some twenty

kinds from Tahiti. He called the breadfruit "the most useful vegetable in the world."

Curiously enough, notwithstanding the interest in the breadfruit, nearly a century passed before the first comprehensive account about it appeared. This by Seemann from Fiji, where the author recognized thirteen varieties, all seedless except one.

Prefacing his description of the breadfruit Seemann says:

"The breadfruit is seen in regular forests, and in a great number of varieties, which the newcomer has some difficulty in distinguishing until he has learned to observe that in the shape of the leaves—which are either entire, pinnatisect or bi-pinnatisect—their size and their either bullate or even surface, the shape and size of the fruits, the time of its maturity, the absence or presence, as well as the length of the prickles on its outside, and the abortion of its ovules or their development into seed, offer good marks of distinction. The general Fijian name for the breadfruit is Uto, signifying "the heart," from the resemblance of the fruit to that organ, while the varieties are distinguished by additional names. Those less frequently cultivated are, however, not known by the same names throughout the group, but bear different ones in the different districts. Hence the exact number of varieties cannot be accurately determined until there shall be a botanic garden in Fiji where a complete collection of breadfruits is cultivated. The principal breadfruit season is in March and April, but some kinds ripen considerably earlier or later, while in some districts the season itself is altogether later. It may thus be said, speaking generally, that there is ripe breadfruit, more or less abundant throughout the year in either one part or the other of the Fiji Islands. The fruit is made into puddings or simply boiled or baked. Quantities of it are preserved underground to make *madrai,* or native bread. Some kinds are best adapted for pudding, some for bread, or culinary purposes of a still more simple description."

Wilkes, of the United States Exploring Expedition, 1844, stated that there were twenty different sorts of breadfruit in Samoa, and nine varieties in the Tonga Islands, but their names have never appeared in print so far as the writer is aware.

In "Gatherings of a Naturalist," 1860, Bennett published an annotated list of twenty-four kinds of breadfruits in Tahiti. In "Eastern Pacific Islands," 1910, Christian enumerates thirty-four varieties in the Marquesas, where according to Ellis in "Polynesian Researches" the breadfruit attains greater per-

fection than anywhere else. Christian also published an annotated list of fifty three breadfruit varieties in the Carolines in "The Caroline Islands," 1899.

In reply to an inquiry about the breadfruits of the Society and the Marquesas Islands Mr. Howard F. Withey, American Consul in Tahiti, under date of April 11, 1922, mailed the writer annotated lists of the breadfruit varieties, including 52 kinds from the island of Tahiti and 25 sorts from the Marquesas. In forwarding these lists Mr. Withey remarks that: "The following report is based upon notes furnished by Dr. Forest B. H. Brown of the Bishop Museum of Honolulu, who has spent over a year and a half investigating the flora of this consular district. For the most part the report is a mere transcription of such notes. Not all the varieties in the Marquesas have been listed but those included have apparently been most thoroughly investigated. Apparently the Marquesas have originated some 25 varieties, and there are at least 50 varieties in the Island of Tahiti in the Society Islands. With one exception all the varieties are seedless. It is believed that by planting judiciously selected varieties a continuous yield of fruit can be obtained. No other fruit in these regions equals the breadfruit in yield. In both the Society Islands and the Marquesas the breadfruit seems to be practically free from diseases and insects pests. As a food there seems to be but one criticism of the breadfruit, i. e., that it does not keep well."

Articles about the breadfruit have previously been published by the writer with a view to attracting interest in this unique fruit. The following list of the breadfruit varieties grown in the Pacific Archipelagoes has been compiled to make conveniently available the scattered information about this subject, to show the remarkable number of forms that have been evolved, also to show how incomplete is our knowledge of them. All the varieties in the following list are seedless unless otherwise indicated. A large number of names are undoubtedly synonyms.

ENUMERATION AND DESCRIPTION

Aano.—The fruit is small, globose, somewhat rough, yellowish green, the facets very slightly conical, elevated. The stem is rather long, 75 mm.; the core small, elongated.[1]

PAPEETE, TAHITI.

Abuabu.—Undescribed.[2]

---

[1] Adapted from notes furnished by Mr. Howard F. Withey, American Consul in Tahiti.

[2] Included in a list of breadfruit varieties growing in Tahiti and the Marquesas furnished by Mr. Withey.

TAHITI.

Aeka.—The fruit is nearly globose, inequilateral, smooth with convex facets; the flesh of "loose" texture. The stem is very short; 2 to 3 cm. long, hairy; the core relatively large, 8 cm. long.[1]

NUKAHIVA, MARQUESAS.

Afara.—The fruit is large, 15 cm. in diameter, spherical, smooth; color very distinctive, brownish red. The stem is slender and slightly hairy. Of excellent qualitly. Rare.[1]

PAPEETE, TAHITI.

Afatu.—The fruit is small and round.[3]

TAHITI.

Anuani.—Undescribed.[4]

TAHITI.

Aoa.—Undescribed.[2]

TAHITI.

Apil.—The fruit is small and round.[5]

PONAPI, CAROLINES.

Atara.—Undescribed.[2]

TAHITI.

Aravei.—The fruit is large, and variable in shape, from spherical to oblong.[1]

PAPEETE, TAHITI.

Auena.—Undescribed.[6]

MARQUESAS.

Aukohi.—The fruit is good, and is quickly roasted.[1]

NUKAHIVA, MARQUESAS.

Aumure.—The fruit is large, 20 cm. across, slightly longer than broad, smooth, with small facets. The stem is short, 5 cm. long.[1]

PAPEETE, TAHITI.

Autea.—Undescribed.[6]

MARQUESAS.

Autia.—The fruit is large, spherical, slightly tuberculate, greenish yellow; core rather large, elongated, edible.[1]

PAPEETE, TAHITI.

Avei.—The fruit has a rough surface.[1]

TAHITI.

Aveu.—The fruit is large, spherical to broadly ellipsoidal, nearly smooth, the facets coarse and slightly elevated. The stem is 75 mm. long.[1]

---

[3] Adapted from Bennett, G., Gatherings of a Naturalist, 1860.
[4] Bennett, G., Gatherings of a Naturalist, 1860.
[5] Adapted from Christian, F. W., The Caroline Islands, 1899.
[6] Christian, F. W., Eastern Pacific lands, 1910.

PAPEETE, TAHITI.

Balekana.—The leaves are pinnatisect, with an even surface. The fruit is small, but of superior quality.[7]

SOMO-SOMO, AND OVALAU, FIJI.

Bokasi.—The leaves are pinnatisect, with an even surface. The fruit is obovate, and smooth. The stem is at first erect, but nodding at maturity of the fruit. An early ripening variety.[7]

FIJI.

Buero.—Undescribed.[4]

TAHITI.

Buko.—The leaves are pinnatisect, with an even surface. The fruit is large, short-ovate, and smooth.[7]

FIJI.

Chai.—The fruit is smooth.[5]

PONAPI, CAROLINES.

Chaniak.—The fruit is small.[5]

PONAPI, CAROLINES.

Dina.—The leaves are pinnatisect with an even surface. The fruit is nearly spherical and smooth. The stem is 10 to 12.5 cm. lang, and nodding throughout the whole period of growth.[7]

FIJI.

En-chak.—The fruit is oblong.[5]

PONAPI, CAROLINES.

En-charak.—The fruit is spiny.[5]

PONAPI, CAROLINES.

En-cherrichang.—The fruit is small, reddish and spiny.[5]

PONAPI, CAROLINES.

En-kaualik.—The fruit is long, with a rough surface.[5]

PONAPI, CAROLINES.

En-kotokot.—The fruit is small and spiny.[5]

PONAPI, CAROLINES.

En-machal.—The fruit is oblong.[5]

PONAPI, CAROLINES.

En-monei.—The fruit is long, slender and spiny.[5]

PONAPI, CAROLINES.

En-paipai.—The fruit is oblong and spiny.[5]

PONAPI, CAROLINES.

En-pakot.—The fruit is long, with a rough surface.[5]

PONAPI, CAROLINES.

En-par.—The fruit is oblong, with a dark, spiny surface.[5]

---

[7] Adapted from Seemann, B. C., Viti, 1862.

PONAPI, CAROLINES.

En-patak.—The fruit is oblong, reddish and spiny.[5]

PONAPI, CAROLINES.

En-pon-chakar.—The fruit is reddish and spiny.[5]

PONAPI, CAROLINES.

En-po-le.—The fruit is oblong.[5]

PONAPI, CAROLINES.

En-put.—A small, round fruit with a rough surface.[5]

PONAPI, CAROLINES.

En-uaoutak.—The fruit is small.[5]

PONAPI, CAROLINES.

En-ucher.—The fruit is long.[5]

PONAPI, CAROLINES.

Faara.—Undescribed.[4]

TAHITI.

Fafaua.—The fruit is large, 13 cm. across, inequilateral, smooth. The stem is long. A good variety.[1]

HIVAOA, MARQUESAS.

Fanum.—Undescribed.[8]

YAP, CAROLINES.

Haparu.—The fruit is large, 20 cm. in diameter, globose, smooth, slightly depressed at base; facets coarse, rather irregular. Of very good quality; cooks quickly.[1]

PAPEETE, TAHITI.

Haupahu.—The fruit is broadly obovoid, 9 by 13 cm., smooth; the facets almost flat, flesh of loose texture around the core. The stem is short, 3 cm. long.[1]

NUKAHIVA, MARQUESAS.

Hetutu.—Undescribed.[6]

MARQUESAS.

Hinu.—Undescribed.[6]

MARQUESAS.

Hoi.—Undescribed.[6]

MARQUESAS.

Huero.—The fruit is spherical, nearly smooth, and contains occasional large seeds. Rare.[1]

PAPEETE, TAHITI.

Impak.—The fruit is large and round.[5]

PONAPI, CAROLINES.

---

[8] Christian, F. W., The Caroline Islands, 1899.

Iofai.—Undescribed.[4]

TAHITI.

Kakanokoe.—Undescribed.[6]

MARQUESAS.

Kalak.—The fruit is small and smooth.[6]

PONAPI, CAROLINES.

Kalasi.—The leaves are bipinnatified. The fruit is oblong and spiny.[7]

FIJI.

Katiu.—The fruit is long.[5]

PONAPI, CAROLINES.

Kiekie koui.—The fruit is large, 15 by 11 cm., broadly ellipsoidal, with a groove around the stem; the flesh loose around the core which is large.[1]

HAKAUI, NUKAHIVA, MARQUESAS.

Kio.—The leaves are pinnatisect. The fruit is almost as large as that of the *Buko.* The surface of the fruit resembles the surface of a shark.[7]

OVALAU, FIJI.

Koka.—Undescribed.[6]

MARQUESAS.

Kokipo.—Seedless; cooks quickly.[1]

NUKAHIVA, MARQUESAS.

Koko.—The leaves are pinnatisect and bullate. The fruit is smooth and of the size of the Dina.[7]

FIJI.

Konini.—The fruit is slightly longer than broad, smooth, with facets nearly flat; the flesh of coarse texture near the core. The stem is long, and the core large.[1]

NUKAHIVA, MARQUESAS.

Koopupu.—The fruit is spherical, smooth, the facets large and flat. The stem is long and the core small.[1]

NUKAHIVA, MARQUESAS.

Koufau.—Undescribed.[6]

MARQUESAS.

Kuahe.—The fruit is inequilateral; the stem very short, 1 cm. only.[1]

NUKAHIVA, MARQUESAS.

Kuanui.—The fruit is medium large, and closely cupped around the stem; the facets are medium large, flat, the flesh firm. The stem is long, and the core small.[1]

NUKAHIVA, MARQUESAS.

Kumar.—The fruit is long.[5]

PONAPI, CAROLINES.

Kuukou.—Undescribed.[6]

MARQUESAS.

Kuuvahane.—The flesh of this fruit is white, and of excellent quality.[1]

HUAHUNA, MARQUESAS.

Letam.—The fruit is small and round.[5]

PONAPI, CAROLINES.

Lipet.—The fruit is large and spiny.[5]

PONAPI, CAROLINES.

Lolo.—The leaves are entire or obscurely lobed in the young plant, changing to entire as the tree grows older. The above is the name of this variety in the Straits of Somo-Somo. In the Rewa district it is called Kokokoko. Possibly identical with Dogodogo and Draukoko.[7]

FIJI.

Luathar.—Undescribed.[8]

YAP, CAROLINES.

Lukual.—The fruit has very long spines.[5]

PONAPI, CAROLINES.

Mahani.—The fruit is large, 20 cm. in diameter, spherical to slightly longer than broad, smooth, the facets nearly even. The stem is from 65 to 75 cm. long.[1]

PAPEETE, TAHITI.

Mai-nior.—Undescribed.[8]

YAP, CAROLINES.

Maie.—Undescribed.[9]

MARQUESAS.

Maire.—The leaves are more cleft than the other varieties. The fruit is large. round and rather smooth. One of the best sorts.[3]

TAHITI.

Maire.—The fruit is small, 125 mm. in diameter, spherical, nearly smooth, yellowish or brownish green. The stem is 75 mm. long, hairy. Of excellent quality. Cooks quickly. The tree is common, and very ornamental and prolific.[1]

PAPEETE, TAHITI.

Mamaitavaka.—The fruit is very small, maximum diameter 14 cm., roundish. The stem is about 4 cm. long, and rather hairy; the core relatively large. The fruit bakes in hot ashes within 10 minutes, is cooked in water in 10 minutes; and tastes more like a potato than any other variety. The tree is quite drought resistant.[1]

HUAHUNA, MARQUESAS.

Maohi.—The fruit is of medium size, spherical or slightly longer than broad, nearly smooth. Cooks slowly and must be baked in a native oven. "Native breadfruit." In general cultivation.[1]

PAPEETE, TAHITI.

Maoi.—Undescribed.[2]

MARQUESAS.

Maore.—Undescribed.[2]

TAHITI.

Mapua.—Undescribed.[6]

MARQUESAS.

Mohomoho.—Undescribed.[6]

MARQUESAS

Momi.—The fruit is very large, sub-spherical, tuberculate; the core small and elongate.[1]

PAPEETE, TAHITI.

Movai.—Undescribed.[6]

MARQUESAS.

Nakont.—The fruit is small and round.[5]

PONAPI, CAROLINES.

Nan-umal.—The fruit is oblong and spiny.[5]

PONAPI, CAROLINES.

Niue.—The fruit is long.[5]

PONAPI, CAROLINES.

Nue.—The fruit is large, round and smooth. The most esteemed variety.[5]

PONAPI, CAROLINES.

Oa.—The fruit is small, spherical or slightly longer than broad, tuberculate. The stem is 75 mm. long.[1]

PAPEETE, TAHITI.

Ofatia.—Undescribed.[4]

TAHITI.

Ohinuhinu.—Undescribed.[2]

TAHITI.

Onape.—Undescribed.[6]

MARQUESAS.

Opiha.—Undescribed.[4]

TAHITI.

Opiripiri.—Undescribed.[2]

TAHITI.

Orihu.—Undescribed.[6]

MARQUESAS.

Otai.—Undescribed.[6]

MARQUESAS.

Otea.—Undescribed.[2]

TAHITI.

Ovai.—The fruit is very large, and of excellent quality.[1]

FATUHIVA, MARQUESAS.

Oviri.—Undescribed.[4]

TAHITI.

Paea.—The fruit is large, 20 cm. in diameter, broadly ellipsoidal, rough, with pointed projections; stem 10 cm. long and glabrous. The cooked flesh is very sticky.[1]

PAPEETE, TAHITI.

Pafai.—Undescribed.[4]

TAHITI.

Pafara.—The fruit is small and round.[4]

TAHITI.

Paifee.—Undescribed.[2]

TAHITI.

Paimach.—The fruit is small.[5]

PONAPI, CAROLINES.

Panafara.—Undescribed.[2]

TAHITI.

Paparu.—Undescribed.[2]

TAHITI.

Patara.—The fruit is very large, 25 cm. in diameter, elliptical-oblong, rough with pointed projections, 6 mm. long, core four times as long as broad. Cooks quickly, and roasts well in the open fire.[1]

PAPEETE, TAHITI.

Patea.—Undescribed.[2]

TAHITI.

Patuki.—The fruit is large, 20 by 14 cm., nearly smooth; the facets slightly concave.[1]

NUKAHIVA, MARQUESAS.

Pavai.—Very large. One fruit is said to be so large as to provide food for ten men.[1]

FATUHIVA, MARQUESAS.

Peau.—Undescribed.[8]

YAP, CAROLINES.

Peetautia.—The fruit is large, 15 cm. in diameter, sub-globose. Rare.[1]

PAPEETE, TAHITI.

Pehi.—Undescribed.[4]

TAHITI.

Peiahuri.—A large, otherwise undescribed fruit.[4]

TAHITI.

Pemathau.—Undescribed.[8]

YAP, CAROLINES.

Pepeti.—The fruit is small, spherical, and smooth; the flesh of inferior quality and requires a long time for cooking. The stem is long and the core small.[1]

NUKAHIVA, MARQUESAS.

Peti.—The fruit is large, sub-globose, depressed at base and flattened at apex, greenish yellow, smooth; the facets slightly concave, with a dark dot in the center. The stem is 5 to 7.5 cm. long, hairy; core small and globose. Of excellent quality.[1]

PAPEETE, TAHITI.

Piia.—Undescribed.[2]

TAHITI.

Piipiia.—A large, otherwise undescribed fruit.[4]

TAHITI.

Pimata.—Undescribed. Said to be very rare. Only one tree is known.[1]

FATUHIVA, MARQUESAS.

Piohe.—Undescribed.[6]

MARQUESAS.

Pipi.—Undescribed.[6]

MARQUESAS.

Pitaeatae.—Undescribed.[6]

MARQUESAS.

Piti.—Undescribed.[6]

MARQUESAS.

Poero.—The fruit is large, 15 cm. in diameter, globose, very rough; the projections conical, 4 mm. long. The stem is 10 cm. long, hairy; the core small and oblong. Of excellent quality. Bakes quickly in the open fire.[1]

PAPEETE, TAHITI.

Pohauta.—The fruit is round, smooth and of excellent quality. The stem is long and stout. Cooks quickly.[1]

HUAHUNA, MARQUESAS.

Pon-panui.—The fruit is long, with a rough surface.[5]

PONAPI, CAROLINES.

Porohiti.—The fruit is small and rough.[1]

PAPEETE, TAHITI.

Poru.—The fruit is large, 20 cm. in diameter, globose, smooth. The stem is 75 mm. long, and hairy.[1]

PAPEETE, TAHITI.

Potopot.—The fruit is oblong, light colored and spiny.[5]

PONAPI, CAROLINES.

Pu or Pupia.—Undescribed.[2]

TAHITI.

Puaa.—The fruit grows several in a cluster, and is spherical and smooth. The stem is about 62 mm. long, and hairy, the core is small.[1]

PAPEETE, TAHITI.

(Introduced from Bora-Bora, another Island in the Society group).

Puahi.—Undescribed.[6]

MARQUESAS.

Puau.—The fruit is large, 20 cm. long, obovoid, inequilateral, smooth, with small facets, the flesh white. The stem is short and the core long. Cooks slowly.[1]

NUKAHIVA, MARQUESAS.

Puaue.—The fruit is large, 20 cm. in diameter, ellipsoidal and smooth.[1]

PAPEETE, TAHITI.

Pufatata.—The fruit is large, broadly ellipsoidal, the facets large and conical. The stem is glabrous, and about 7.5 cm. long.[1]

PAPEETE, TAHITI.

Pulang.—The fruit is large and smooth.[5]

PONAPI, CAROLINES.

Puou.—The fruit is large, weighing five kilos, smooth, the flesh yellow and of excellent quality. Cooks quickly.[1]

HIWAOA, HUAHUNA, MARQUESAS.

Pupupi.—Undescribed.[6]

MARQUESAS.

Purerு.—Undescribed.[2]

TAHITI.

Puupuu.—Undescribed.[2]

TAHITI.

Puvero.—Undescribed.[2]

TAHITI.

Rare.—The fruit is large, 15 cm. long, ellipsoidal, smooth, with slightly elevated facets. The stem is 7.5 cm. long, hairy, the core oblong. Of excellent quality.[1]

PAPEETE, TAHITI.

Raumae.—Undescribed.[2]

TAHITI.

Rautia.—Undescribed.[4]

TAHITI.

Rauvaravara.—Undescribed.[2]

TAHITI.

Rokouta.—The leaves are pinnatisect, with a bullate surface, giving the tree a diseased appearance.[7]

NAMARA, FIJI.

Roru.—Undescribed.[4]

TAHITI.

Sore.—The leaves are pinnatisect, with an even surface. The only seedy variety is Fiji. Known under the above name is Rewa; as *Vaka Sorena* in Ovalau; as *Asalea* in the Straits of Somo-Somo; as *Maliva* in Nukubalaon; all in Fiji.[7]

FIJI.

Taataa.—The fruit is very rough, and the flesh is lumpy when ripe, but of good quality.[1]

HUAHUNA, MARQUESAS.

Taataatoetoe.—The fruit is inequilateral, smooth and of good quality. The stem is short and smooth, the core 10 cm. long.[1]

HIWAOA, MARQUESAS.

Tafara.—Undescribed.[2]

TAHITI.

Tágafei.—Undescribed.[8]

YAP, CAROLINES.

Taik.—The fruit is large and smooth.[5]

PONAPI, CAROLINES.

Tahaka.—Undescribed.[6]

MARQUESAS.

Takai.—The fruit is round, and very hard.[5]

PONAPI, CAROLINES.

Tal.—The fruit is small, dark and spiny.[5]

PONAPI, CAROLINES.

Tao.—Undescribed.[2]

TAHITI.

Tapa.—Undescribed.[6]

MARQUESAS.

Tatara.—Undescribed.[2]

TAHITI.

Teve.—Undescribed.[6]

MARQUESAS.

Ti.—The fruit is oblong and spiny.[5]

PONAPI, CAROLINES.

Tiatea.—Undescribed.[2]

TAHITI.

Tioe.—Undescribed.[6]

MARQUESAS.

Toerau.—The fruit is large, spherical to ellipsoidal, and smooth.[1]

PAPEETE, TAHITI.

Tohetupou.—Undescribed.[2]

TAHITI.

Tookaha.—The fruit is large, up to five kilos in weight, the flesh of excellent quality. The largest breadfruit in the northern group. Said not to fruit every year.[1]

NUKAHIVA, HUAHUNA, MARQUESAS.

Tona.—Undescribed.[6]

MARQUESAS.

Touarau.—Undescribed.[2]

TAHITI.

Tuavera.—Undescribed.[2]

TAHITI.

Tutou.—The fruit is inequilateral, slightly longer than broad, 17 by 12 cm., the facets convex; the core short.

NUKAHIVA, MARQUESAS.

Tuutou.—The fruit is large, 20 cm. long, obovoid, nearly smooth, yellowish green to brownish; the facets small, slightly raised. The stem is short, about 25 mm. long, the core elongated. Of excellent quality.[1]

PAPEETE, TAHITI.

Uaka.—The fruit is large, oblong and spiny.[5]

PONAPI, CAROLINES.

Uea.—Undescribed.[6]

MARQUESAS.

Vaeoaeota.—The fruit is seedless and of good quality.[1]

NUKAHIVA, HIWAOA, MARQUESAS.

Varaka.—The leaves are pinnatisect, and larger than in any other variety in Fiji. The fruit is of medium size, with a rough surface.[7]

FIJI.

Vevee.—Undescribed.[6]

MARQUESAS.

Vonu.—The leaves are pinnatisect. The fruit is large.[7]

SOMO-SOMO, FIJI.

Votovoto.—The leaves are pinnatisect, with an even surface. The fruit is oblong, and the surface covered with spines about 8 mm. long.[7]

FIJI.

Yae-reb.—Undescribed.[8]
YAP, CAROLINES.

Yao-lei.—Undescribed.[8]
YAP, CAROLINES.

Yao-uat.—Undescribed.[8]
YAP, CAROLINES.

Yeo-tui.—Undescribed.[8]
YAP, CAROLINES.

Iao-tathen.—Undescribed.[8]
YAP, CAROLINES.

Yong.—The fruit is small.[5]
PONAPI, CAROLINES.

Yu-goi.—Undescribed.[8]
YAP, CAROLINES.

Yu-ngalu.—Undescribed.[8]
YAP, CAROLINES.

DIRECTIONS FOR SAVING AND KEEPING VEGETABLE AND OTHER SEEDS

By P. J. WESTER

GENERAL REMARKS

Good seed is a prime requisite for a good harvest of all field and garden crops. How to procure seeds of good quality in adequate quantities at a reasonable price is an annually recurring problem to many farmers in this country. Frequently many vegetables are not planted because seeds cannot be procured. On the other hand observations covering many years have shown the writer that considerable effort is wasted in saving seed that might have been put to a better purpose.

This paper has been prepared with a view to clearing away some of the misconceptions on this subject and to assist in getting a more plentiful supply of homegrown seed of good quality.

It is a well-known fact to all residents of the Islands who have tried their hand at growing vegetables that the seeds of so-called temperate vegetables, such as cabbage, rutabagas, turnips, and onions lose their viability within a few weeks, especially if they are exposed to the air, or become infested with weevils. Some of them do bear seeds but the vegetables grown therefrom are so inferior to those grown from imported seeds and the expense of gathering them is relatively so great that it does not pay to save seeds from them. It is greater all around economy to plant imported seeds.

There are numerous vegetables of tropical origin, however, which produce excellent seeds abundantly in this country at a very slight cost for gathering that it is difficult, frequently impossible, to obtain from seed dealers in foreign countries, and even when obtainable cost much more than if they had been produced at home. If properly dried and stored they keep from harvesting to planting season without marked deterioration.

PLANTS OF WHICH IT IS INADVISABLE TO SAVE SEED

The following is a list of plants of which it is inadvisable to collect seed for future planting. Imported seeds are cheaper and give better results. The ordering of these seeds should be timed so that they will arrive at their destination about when the planting season begins. They should be sown at the earliest practicable date after arrival. If they are not sown at once, they should be placed in clean air tight jars, bottles, or tin cans and stored away in a dry, cool, dark place until they are planted.

Beet	Kohlrabi	Pechay
Cantaloupe	Leek	Radish
Carrot	Lettuce	Rape
Cauliflower	Mustard	Rutabaga
Celery	Onion	Turnip
Dill	Parsley	Watermelon
Endive	Parsnip	

PLANTS OF WHICH IT IS ADVISABLE TO SAVE SEED

Seeds of good quality of several imported vegetable and field crops are produced in sufficient abundance to warrant saving them for planting for from 3 to 6 generations, but with each generation the product deteriorates and finally it again becomes necessary to reimport seed from the temperate zone. This statement applies to these crops under ordinary field practice. Systematic acclimatization and breeding work quite likely would yield varieties well adapted to Philippine conditions that could be propagated here indefinitely. The foregoing statement refers to the following plants:

Beans (bush and climbing)
Cowpeas
Patani (imported bush and climbing varieties)
Peas
Potatoes
Sunflowers

Of these the seed of six generations of cowpeas can be saved successively, while the other plants ordinarily "run out" within from three to four generations.

The saving of seed on the farm is recommended for the following crops, enumerated under A, B, C, D, and E.

A. GRAINS AND LEGUMES

Adlay	Borona
Anipay	Corn
Batao	Guar
Beans:	Kadios
Lyon	Kambu
Marutong	Kodo
Patani (native)	Mungo
Seguidilla	Ragi
Sitao	Rice
Velvet	Sorghum
Sinkama	
Soya	

The stalks of the grains should be cut so as to leave a convenient "handle," and the heads tied in bundles and dried. In regions with a well marked wet and dry season they ripen after dry weather has begun. Here the drying is best effected in the open. In districts where the weather is uncertain during the harvest period the bundles should be hung up to dry in a shed. When thoroughly dried the grains should be threshed and cleaned, except corn, which may be left in the husk if desired.

The pods of the different legumes should be allowed to remain on the plants until they have changed color and become dry, and the seeds or beans have hardened. They should then be picked. They will still contain some excess moisture, and therefore should be placed on canvas sheets or shallow trays in the sun, and stirred now and then to insure even drying. After a few days' exposure in the sun the pods will be so dry and brittle that they can be threshed by placing them in gunny sacks and beating them with flails, after which the seeds can easily be cleaned. Then, to insure thorough drying of all seeds it is well to expose the cleaned seed in the sun, spread thin in shallow trays for a couple of days before they are stored away. They should be allowed to cool over night before being placed in storage if the receptacles used are of any considerable size.

B. PLANTS WITH PARTLY DRIED PODS

Okra	Sesame
Roselle	Talinum

The seed pods should be gathered as soon as they change color, before the seed shatters, and placed on trays to dry in the sun. If the plants are not carefully watched, much of the

seed is apt to be lost. When they are pointing downward the seed pods of the talinum are ready for gathering. When thoroughly dried treat the seeds as already recommended for the grains and legumes.

C. FLESHY VEGETABLES

These include plants the seed of which are embedded in a fleshy, more or less watery pulp from which they must be cleaned before they are dried. They include:

Apalia	Kondol	Pumpkin
Chili	Pakupis	Squash
Eggplant	Patola	Tomato
Cucumber	Pepper	Upo

The fruits should be allowed to remain on the plants until fully mature as shown by their color. They should then be opened with a knife or bolo and the seeds scraped out. More or less of the pulp, according to their kind, will adhere to the seed, and the mass should be left in a bucket for two or three days, or just long enough for the pulp to decay sufficiently so that it can be easily washed away from the seed. The seeds should then be rinsed in several waters until the last water remains clear. After which they should be placed thinly in shallow trays, put in a semi-shaded spot, and stirred from time to time until the entire lot is well dried, say two or three days They should then be stored away as previously directed for the grains.

D. TUBERS, ETC.

Arrowroot	Kemili	Shallots
Artichoke	Nami	Tongo
Gabi	Potato	Ubi
Garlic	Sapang	Yautia
Ginger	Sembu	

These plants are not propagated from seed but from tubers or sets.

As the crops of these plants are harvested, bruising the tubers should be guarded against because this invites decay. They should be cleaned of adhering soil and spread thin in the shade to dry for a few days to allow the surplus moisture to evaporate. Finally, they should be stored away in a cool, dry, dark, rat-proof place.

E. MISCELLANEOUS CROPS

For treatment of rice, corn, peanuts, and tobacco seeds, see the bulletins and circulars issued about these crops.

Chayote.—The seeds cannot be removed from the fruits of this plant, which should be stored away in a cool, dark place until planting time.

Libato.—The fleshy covering of the seeds should be washed off in clean water, and the seeds dried in the shade before storing.

Spinach, New Zealand.—This excellent vegetable for the mountain regions produces seeds in abundance, which should be gathered when ripe, and then dried before storing.

Cassava.—Enough plants from which to procure seed canes should be left in the ground. The mature canes will keep alive several weeks if they are stored in a dark, cool place, and occasionally sprinkled with water.

Kamote.—This plant is so easily propagated from cuttings that there is no need to preserve tubers for propagation.

SEED CONTAINERS

All containers should be thoroughly cleaned before they are used, and the fresh seeds should be placed in the container as soon as dried. They should not be allowed to lie about the barn or bodega for several days, as this invites infestation by weevils and other stored-grain pests. After the seeds have been placed in the containers these should be closed at once.

Clean, dry glass jars and bottles will be found serviceable containers for small amounts of seed. For larger quantities kerosene or gasoline tins will be found to answer the purpose.

In this country it is important that the containers in which the seed is kept are air tight so as to exclude moisture as well as insects.

Little trouble in this respect need be anticipated with jars and bottles, but with large tins a hole of suitable size should be made in the center of the top, say 15 centimeters in diameter. A throat about 5 centimeters high should be soldered around the hole, about 25 millimeters outside of which on the top of the can a flange 25 millimeters high should be soldered. The cover should be made about as high as the throat, and so that it fits over this on the outside. The space between the flange and the throat should be filled with naphthalene. Since when the cover is placed in position its lower rim rests in the naphthalene, this will prevent the entrance into the can of weevils and other noxious insects. See figure 1.

For cultural directions of vegetables and field crops, see circular No. 119.

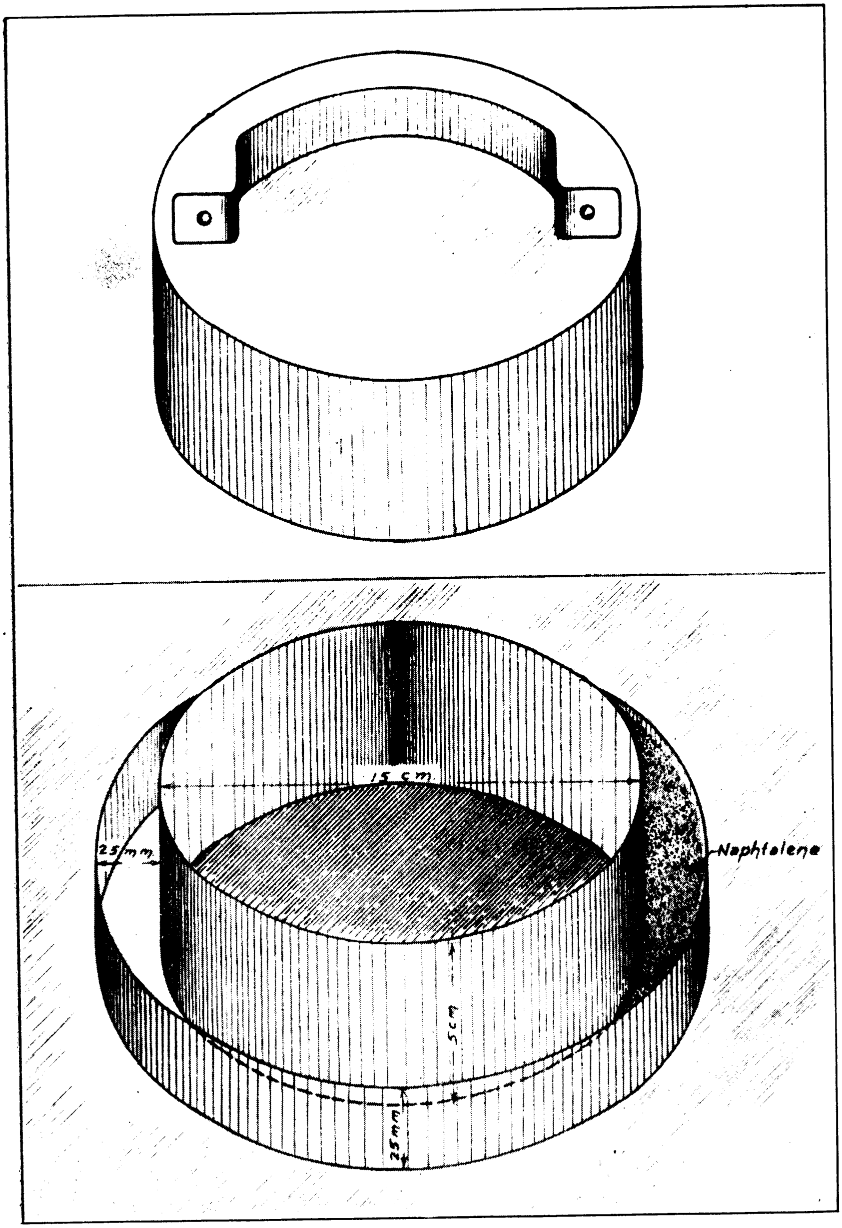


FIG. 1. Mouth and cover for an insect proof seed container.

For a complete list of all the known dialectal names in the Philippines of the plants mentioned in this paper, accompanied by descriptions, see the "Food Plants of the Philippines."

THE PREPARATION AND PACKING OF SEEDS AND SCIONS OF TREES AND SHRUBS IN THE TROPICS

By P. J. Wester

INTRODUCTION

In the Temperate Zones practically all seeds may be dried and still retain their viability, whereas in the Tropics the seeds of many species, for instance, such important plants as the tea, coffee, cacao, mango, and the mangosteen, lose their germinative power if they are allowed to dry out. Many years of experience in plant introduction and distribution work by the writer has shown that there is so much confusion in the minds of most people as to which seeds can safely be dried without deterioration, and which must be kept damp in order to germinate that it has seemed advisable to prepare lists of the different fruits found in the Philippines according to how their seeds should be treated.

Among the multitude of timbers and other trees of economic value or woody ornamental plants, though there are many exceptions, it is a safe rule to pack seeds obtained from fleshy or pulpy fruits in a moist medium, while those which ripen dry in their receptacles do not require special packing.

So far as possible, seeds should be obtained only from ripe fruits. If the fruit is not quite ripe when it is picked, it should be laid in a box or on a table to ripen before the seeds are removed. Then, when the seeds are removed from the fruit, they should be washed free of all pulp in fresh water, the pulpy water poured off and the seeds rinsed repeatedly in several waters until the water runs off clear. At the same time care should be taken to see that they are not injured in the course of washing. Excepting seeds with a hard bony shell like the mango, *they should never be scraped with knives or sticks.* The cleaning is facilitated by placing the seeds with adhering pulp (after they have been removed from the fruit) in a box and allowing them to lie and ferment for a day or two, depending on how fast the pulp decays. The seeds can then be easily cleaned of pulp and fruit juice, which make a

favorable breeding ground for fungi, and also attract insect pests if allowed to dry on the seeds.

When the seeds are clean, they should be spread out to dry on a table, a large sheet of Manila paper, or a blotter.

TREES AND SHRUBS THE SEEDS OF WHICH WILL RETAIN THEIR VIABILITY WITHOUT MOIST PACKING

Seeds that are of such nature that they can be stored dry and still retain their germinative power, after being cleaned, should be allowed to lie exposed and dry for a couple of days, being stirred now and then to insure even drying, and then stored away in clean, dry containers until planting time. Or, if they are to be shipped some distance, they may be placed in paper or cloth bags and sent through the mail without further packing than to protect them from mechanical injuries.

Species belonging in this group are as follows:

ALAGA. *Uvaria sorsogonensis*
ALAGADISSO. *Annona spinescens*
ALAKAO. *Palaquium philippense*
ANIGLI. *Annona senegalensis*
ANILAU. *Grewia eriocarpa*
ATIBU. *Rubus pectinellus*
AYO. *Tetrastigma harmandi.*
BAGEJA. *Canarium moluccana*
BALUKO. *Grewia philippinensis*
BANAUAK. *Uvaria rufa*
BIGNAY. *Antidesma bunius*
BIKA. *Ampelocissus martini*
BIRIBA. *Rollinia orthopetala*
BITUNGOL. *Flacourtia indica*
BLACKBERRY. *Rubus nigrobaccus*
BRAZIL NUT. *Bertholletia nobilis*
BRITOA. *Britoa acida*
BUNYA. *Araucaria bidwillii*
CAIMITILLO. *Chrysophyllum oliviforme*
CAIMITO. *Chrysophyllum cainito*
CAROB. *Ceratonia siliqua*
CASHEW. *Anacardium occidentale*
CATTLEY. *Psidium cattleianum*
CEFALUS. *Sarcocephalus esculentus*
CHERIMOYA. *Annona cherimolia*
CHESTNUT. *Castanea sativa*
CHICO. *Achras zapota*
CIRUELA. *Spondias purpurea*
CITRON. *Citrus medica*
COPELA. *Rubus copelandi*
CUSTARDAPPLE. *Annona reticulata*
CYNDRA. *Cyphomandra betacea*
DALINSI. *Terminalia edulis*
DAMIA. *Macadamia ternifolia*
DAO. *Dracontomelum dao*
DATE. *Phoenix dactylifera*
DAUAG. *Capparis micracantha*
DENDE. *Elaeis guineensis*
DOWNY MYRTLE. *Rhodomyrtus tomemtosus*
FEIJOA. *Feijoa sellowiana*
GENIPA. *Genipa americana*
GISAU. *Canarium williamsii*
GRANADILLA. *Passiflora quadrangularis*
GRAPE. *Vitis*, all species
GUANABANO. *Annona muricata*
GUAVA. *Psidum guajava*
GUISARO. *Psidium molle*
HEVI. *Spondias cytherea*
HONDAPARA. *Dillenia indica*
IBA. *Cicca disticha*
ICACO. *Chrysobalanus icaco*
ILAMA. *Annona diversifolia*
IMBU. *Spondias tuberosa.*
INYAM. *Antidesma ghaesembilla.*
KABIKI. *Mimusops elengi*
KABUYAO. *Citrus hystrix*
KAKI. *Diospyros kaki*
KALAMONDIN. *Citrus mitis*
KALPI. *Citrus webberi*
KAMIRING. *Semecarpus cuneiformis*

KANARI. *Canarium commune*
KAONG. *Arenga pinnata*
KARANDA. *Carissa carandas*
KAYAM. *Inocarpus edulis*
KETEMBILLA. *Dovyalis hebecarpa*
KOTMO. *Vaccinium whitfordi*
KUNAKUN. *Elaeocarpus calomala*
LAMIO. *Dracontomelum edule*
LANAGON. *Flacourtia euphlebia*
LANÑO. *Spondias pinnata*
LAURIVA. *Psidium laurifolium*
LEMON. *Citrus limonia*
LILIKOI. *Passiflora edulis*
LIME. *Citrus aurantifolia*
LIMON REAL. *Citrus excelsa*
LINAS. *Uvaria purpurea*
MANDARIN. *Citrus nobilis*
MIARAY. *Citrus miaray*
MOMBIN. *Spondias lutea*
MULING. *Grewia stylocarpa*
NALA. *Tetrastigma loheri*
NARANJILLA. *Solanum quitoense*
NELLI. *Phyllanthus emblica*
ORANGE. *Citrus aurantium*
PALANAU. *Rubus fraxinifolius*
PANIALA. *Flacourtia cataphracta*
PAPAYA. *Carica papaya*
PARCHA. *Passiflora laurifolia*
PEACH. *Prunus persica*
PEKOLA. *Mimusops kauki*
PERESKIA. *Pereskia aculeata*
PERUNKILA. *Carissa sp.*
PHALSA. *Grewia asiatica*
PILAY. *Rubus niveus*
PILI. *Canarim ovatum*
PINEAPPLE. *Ananas comosus*
POHA. *Physalis peruviana*
POMEGRANATE. *Punica granatum*
POMELO. *Citrus maxima*
RAGINI. *Rubus rosaefolius*
ROSELLE. *Hibiscus sabdariffa*
SERALI. *Flacourtia ramontchi*
SONCOYA. *Annona purpurea*
SUGARAPPLE. *Annona squamosa*
TAMARIND. *Tamarindus indica*
TAMISAN. *Citrus longispina*
TIBAO. *Rubus elmeri*
TITAO. *Rubus ellipticus*
TUNGULU. *Carissa grandiflora*
UMKOLO. *Dovyalis coaffra*
UVERO. *Coccolobis uvifera*
VILATTI. *Feronia limonia*
VOAVANGA. *Vangueria madagascariensis*
YARUMA. *Cecropia palmata*

SEEDS WHICH REQUIRE SPECIAL PACKING

Seeds belonging to a class which rapidly loses viability, either must be planted at once after being cleaned, or else packed in a damp medium, such as soil or sand until they are planted.

If such seeds are to be shipped to some other point, after being cleaned they should be spread out thin to dry for about three or four hours, or long enough to allow the excess surface moisture to dry off. While in the process of drying fruit tree seeds in the Tropics should always be kept *in the shade.* It is true that some fruit tree seeds are not injured by the heat of the sun, but many others are more or less injured and frequently killed by exposure to the sun.

When the seeds are sufficiently dried, that is, when the surface moisture has dried off, they should be packed at once in tins or oiled paper, in moist sphagnum moss, coconut fiber dust, or powdered charcoal. Well weathered sawdust makes an excellent packing medium. Just enough clean fresh water should be added to the packing medium so that in squeezing a handful it feels moist *but not wet.*

Excess moisture should be guarded against as that will start premature germination or decay before the seeds arrive at their destination. If oiled paper is used as a wrapper, the package in addition should be wrapped in strong Manila paper for an outer covering before it is placed in the mails.

In all cases, sufficient packing material should be mixed with the seeds to keep them well separated from each other. Thus, if decay starts in some seed it will not spread so rapidly to the others. Especially in bulky shipments, seeds are liable to heat in transit if an insufficient amount of packing medium is packed with the seed.

In remote localities where other good packing material is not procurable, soil, preferably dug from a depth of 20 to 30 centimeters beneath the surface of the land, will serve as a substitute.

All waste space should be filled with packing so that the seeds cannot move about while in transit.

Seeds of the following species require moist packing to safely reach their destination:

ADANG. *Eugenia calubcob*
AGLAÑO. *Hedyachras philippinensis*
AKEE. *Blighia sapida*
ALPAY. *Euphoria didyma*
ALUAO. *Euphoria nephelioides*
ANTOL. *Garcinia vidallii*
AVOCADO. *Persea americana*
BACHANG. *Mangifera foetida*
BALUBAT. *Eugenia claviflora*
BANAGO. *Gnetum gnemon*
BANANA. *Musa sapientum*
BANGAR. *Sterculia foetida*
BANITI. *Garcinia dulcis*
BAROBO. *Diplodiscus paniculatus*
BAUNO. *Mangifera caesia*
BAYANI. *Dillenia megalantha*
BAYANTI. *Aglaia harmsiana*
BERBA. *Rheedia edulis*
BINUKAO. *Garcinia binucao*
BOBONAO. *Aglaia everittii*
BORACHO. *Lucuma salicifolia*
BREADFRUIT. *Artocarpus communis*
BULALA. *Nephelium mutabile*
BULSO. *Gnetum indicum*
BUNAG. *Garcinia benthami*
BUOL. *Ximenia americana*
CACAO. *Theobroma cacao*
CANISTEL. *Lucuma nervosa*
CARAMBOLA. *Averrhoa carambola*
CHERPU. *Garcinia prainiana*
CHICO-MAMEY. *Calocarpum sapota*
CINNAMON. *Cinnamonum zeylanicum*
COFFEE. *Coffea*, all species
COYO. *Persea schiedeana*
DALUBI. *Zalacca clemensiana*
DANEALAN. *Garcinia subelliptica*
DUHAT. *Eugenia cumini*
DUKU. *Lansium domesticum duku*
DURIAN. *Durio zibethinus*
GALO. *Anacolosa luzonensis*
GANDARIA. *Bouea macrophylla*
GOMIHAN. *Artocarpus elastica*
GRUMICHAMA. *Eugenia dombeyi*
HUANI. *Mangifera odorata*
IGANG. *Eugenia garciae*
INOGUG. *Eugenia sp.*
JAK. *Artocarpus integra*
KABANGLA. *Garcinia mindanaensis*
KALAPI. *Calamus ornatus*
KALAYO. *Erioglossum rubiginosum*
KAMANCHILE. *Pithecolobium dulce*
KAMANI. *Garcinia rubra*
KAMBOG. *Dillenia mindanaense*

KAMI. *Cinnamonum mindanaense*
KAMIA. *Averrhoa bilimbi*
KAMINGI. *Litchi philippinensis*
KATURI. *Garcinia venulosa*
KUBILI. *Cubilia blancoi*
LAMUTA. *Cynometra cauliflora*
LANZON. *Lansium domesticum*
LAPINI. *Eugenia xanthophylla*
LEMASA. *Artocarpus champeden*
LIMONCITO. *Triphasia trifolia*
LINGARO. *Elaeagnus philippinensis*
LIPOTI. *Eugenia curranii*
LITCHI. *Litchi chinensis*
LITOKO. *Calamus sp.*
LONGAN. *Euphoria longana*
LOQUAT. *Eriobotrya japonica*
LUNAU. *Otophora fruticosa*
MABOLO. *Diospyros discolor*
MADRONO. *Rheedia madrono*
MAIGANG. *Eugenia polycephaloides*
MAKOPA. *Eugenia javanica*
MALABU. *Garcinia cumingiana*
MALPI. *Malpighia glabra*
MAMATA. *Lansium dubium*
MAMEY. *Mammea americana*
MAMONCILLO. *Melicocca bijuga*
MANALAU. *Aglaia oligantha*
MANDALIKA. *Artocarpus rigida*
MANGO. *Mangifera indica*
MANGOSTEEN. *Garcinia mangostana*
MANKIL. *Eugenia mananquil*
MARANG. *Artocarpus odoratissima*
MATASANO. *Casimiroa edulis*
ONANI. *Eugenia lancilimba*
PAHO. *Mangifera altissima*
PALALI. *Dillenia riefferscheidia*
PANGI. *Pangium edule*
PILDIS. *Garcinia dives*
PITANGA. *Eugenia uniflora*
RAMBI. *Baccaurea motleyana*
RAMBUTAN. *Nephelium lappaceum*
SALAK. *Zalacca edulis*
SANTOL. *Sandoricum koetjape*
TAMBIS. *Eugenia aquea*
TAMIL. *Garcinia tetrandra*
TEA. *Thea sinensis*
TEBDAS. *Calamus mitis*
TERSANA. *Eugenia malaccensis*
TULANA. *Eugenia aherniana*
UAY. *Calamus usitatus*
WAMPI. *Clausena lansium*
YAMBO. *Eugenia jambos*
ZAPOTE. *Diospyros ebenaster*

Other important crops the seeds of which must be packed in a most medium include Para rubber, abacá or Manila Hemp, nutmeg, clove, and camphor.

On arrival the seeds should be planted at once and not allowed to be exposed and to dry out.

SCIONS AND CUTTINGS

Scions or cuttings should always be made from well matured growths. The leaves and spines, if any, should be cut off with a sharp knife, leaving about two or three millimeters of the leaf-stalks.

In special cases, as with the mango, cacao, or the cherimoya and related plants, where the scions must be naked, if suitable scions are not immediately available on a tree, the leaf blades should be cut off from a number of straight well matured twigs, of about the thickness of a lead pencil. In the course of three weeks, the leaf-stalks will have dropped, and well healed scars have formed upon the twigs. These are then ready to be cut for scions and packed.

It is important that scions and cuttings immediately after being cut from the parent plant, be covered with a moist cloth or plunged into damp sphagnum moss or sawdust until they are being packed for shipment. Much material fails to survive and yield good results because it was carried about uncovered, and exposed to the sun while being carried from the orchard to the packing shed, especially if the leaves were not trimmed off. The evaporation from all living tissue in the Tropics exposed to the sun and hot air in the daytime is far greater than most people realize, but is easily noted by watching how rapidly the leaves and tender twigs wither and dry up on a plant severed from the root and allowed to lie exposed in the sun.

Before being packed the ends of the cuttings should be trimmed off smooth with a sharp knife, after which each cutting should be wrapped separately in damp, soft Manila paper or newspaper before being tied into a bundle, or packed in damp sphagnum moss or sawdust, so that the cuttings do not touch. The bundle should then be placed in a tin or else wrapped in oiled paper to prevent the escape of moisture, outside of which should be placed a coat of corrugated paper, finally wrapped in stout Manila paper.

In the Tropics bamboo joints make good containers for cuttings and scions, but they must be water-proofed for long distance shipments, or else the scions wrapped in oiled paper before being placed in the joint. Vacant spaces in a tin or bamboo joint should be filled with waste paper so that the plant material cannot knock about loosely while in transit.

The different Philippine dialectal names accompanied by descriptions of all the fruits enumerated in this article will be found in the "Food Plants of the Philippines," a publication issued by this Bureau.

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF AGRICULTURE
MANILA

ADMINISTRATIVE ORDER No. 29

REGULATIONS GOVERNING THE IMPORTATION AND EXPORTATION OF PLANT MATERIALS TO AND FROM THE PHILIPPINE ISLANDS (REVISED)

The Director of Agriculture is authorized by Legislative Act No. 3027, approved March 8, 1922, to regulate the importation and exportation of plant materials into and from the Philippine Islands, for the purpose of protecting the crops of the Philippines from foreign plant diseases and injurious insects. Pursuant to said Act, the following rules and regulations are hereby promulgated:

SECTION 1. *Definitions.*—For the purpose of these regulations the terms herein used are defined as follows:

(*a*) "Person" shall mean both singular and plural, as the case demands, and shall include corporations, societies, and associations and their agents and employees.

(*b*) "Plant materials" shall include living plants, fruits, seeds that can be used for reproduction purposes, cuttings, bulbs and corms, grafts, leaves, roots, scions, and fruit pits.

(*c*) "Plant Quarantine Inspector" shall mean any person so designated by the Director of Agriculture to act as the latter's representative and having a written appointment issued by the Director of Agriculture.

(*d*) "Disinfection" shall mean any treatment applied for the purpose of destroying any infection or infestation that may occur on or amongst plant materials subject to these regulations.

SEC. 2. *Plant materials for which permit is required.*—Plant materials which are governed by special quarantine and other restrictive orders now in force, and which may hereafter be made the subject of special quarantines, may be imported in limited quantities, under permit from the Director of Agricul-

ture, from countries which maintain inspection, for the purpose of keeping this country supplied with new varieties and necessary propagating stock. The same plant materials may also be imported in limited quantities, under quarantine, from countries not maintaining inspection, provided they are to be used for experimental purposes only, subject to such conditions that the Director of Agriculture may impose. The importation of such plant materials for the purposes specified above, shall only be made through the port of Manila, upon compliance with the administrative orders governing them respectively, and with these regulations.

The following is the list of the plant materials which are covered by special quarantines, and the Administrative Orders governing each one of them, respectively:

Musa and allied plants (Administrative Order No. 30).
Coconuts (Administrative Order No. 31).
Sugar Cane (Administrative Order No. 32).
Rice (Administrative Order No. 33).
Importation of fruits (list attached) from countries infested with Mediterranean fruit-fly, *Ceratitis capitata* (Administrative Order No. 34).
Pineapple (Administrative Order No. 35).
Bamboo (Administrative Order No. 36).
Tobacco (Administrative Order No. 37).

SEC. 3. *Application for permits for importation of plant materials.*—All persons who intend to import plant materials the entry of which is prohibited under section 2, shall first make application to the Bureau of Agriculture Form No. 251 or Form No. 252, as the case may be. Applications for permit must be made in advance of the shipment of the plant materials.

SEC. 4. *Issuance of permits.*—On approval by the Director of Agriculture of an application for importation of plant materials, a permit will be issued in quadruplicate (Bureau of Agriculture Form No. 253). The original copy will be furnished to the applicant for presentation to the quarantine inspector at the port of entry, the duplicate will be forwarded to the quarantine inspector at the port of entry, the third copy will be furnished the Collector of Customs, and the fourth copy will be filed with the application. Before the issuance of such a permit, however, the Director of Agriculture may, for the compliance with the conditions imposed in these regulations, require the importer to file a bond in the amount of twice the invoice cost of the plants imported.

SEC. 5. *Notice of arrival by permittee or other persons bringing into the country plant materials.*—Immediately upon arrival of plant materials at the port of entry, the permittee or the person bringing into the country plant materials shall submit in duplicate to the Director of Agriculture an application for inspection upon a form provided for that purpose (Bureau of Agriculture Form No. 254) stating the number of permit, date of entry, name of ship or vessel, the country and locality where grown, name of exporter, name of importer, agent or broker at the port of entry, and character and quantity of plant materials.

SEC. 6. *Notice of shipment by permittee.*—After entry of the plant materials and before removal from the port of entry of each separate shipment or consignment thereof, the permittee shall notify the Director of Agriculture on the form provided for the purpose (Bureau of Agriculture Form No. 255) stating the number of the permit, the date of entry, the name and address of consignee to whom it is proposed to forward the plant materials, the amount to be shipped, and the probable date of shipping and route of transportation. A separate report is required of each ultimate consignee.

Plant materials which have been once inspected and passed by a duly authorized plant inspector may be moved from place to place (inter-provincial shipment) without restrictions other than those imposed on the inter-provincial movement of domestic plant materials. To prevent any delay in the shipment and movement of the plant materials the goods covered may be shipped immediately after due notice to the Director of Agriculture. However, the permittee is cautioned that this notice must always be furnished prior to shipment or movement of the plant materials, and that failure to submit these reports prior to the shipment and movement may result in the revocation of permits and the application of the penalties prescribed by the Legislative Act No. 3027.

SEC. 7. *Revocation of permits.*—Permits may be revoked and further permits refused for the importation of the products of any grower or exporter of any foreign country who has violated Legislative Act No. 3027 or any rules and regulations promulgated thereunder; or for the importation of the products of any country where inspection is considered by the Bureau of Agriculture, as the result of its examinations of importations therefrom, to be merely perfunctory, or for the failure of permittee

to give the notice required by these rules and regulations, or for the giving of a false or incomplete notice, or the intentional mislabeling of any shipment, or failure to comply with any rules and regulations issued thereunder. Further, any permit issued by the Director of Agriculture may be revoked by him at any time if in his judgment the interests of the public and the service so require.

SEC. 8. *Conditions of entry; foreign certificate of inspection required; inspection and certification; disinfection or fumigation; freedom from sand, soil, or earth; and approval of packing materials.*—Persons who import or bring in articles bearing certification that they are free from fungi and insects, issued by the inspector from the country of origin, shall be required to present the certificate therefor to the office of the plant inspector. Presentation of such a certificate, however, shall not preclude inspection by the plant quarantine officials of this country if an inspection is deemed necessary.

All persons who intend to import plant materials must submit to the Bureau of Agriculture an application for inspection of incoming plants, upon a form provided for the purpose (Bureau of Agriculture Form No. 256) on or before the arrival of such shipment. All such plant materials shall be inspected upon arrival for parasitic fungi and injurious insects. All plants which are found to be free from insect pests and diseases shall be certified and tagged with Bureau of Agriculture Form No. 257 or stamped. Such plants after having been so tagged or stamped shall then be allowed to enter. Plant materials which are found to be infested by insect pests or infected with diseases shall be returned to the point of origin or destroyed, at the option of the importer; in either case the cost shall be borne by the importer.

Plant materials imported under section 2 hereof shall, at the expense and responsibility of the importer, be subject as a condition of entry to such disinfection or fumigation as may be required by the Plant Quarantine Inspectors, and may be isolated in places designated by the Director of Agriculture until evidence is available showing that no injurious insects or parasitic fungi are present on such plants.

All plant materials offered for import must be free from sand, soil, or earth, and all plant roots, rhizomes, tubers, etc., must be washed to thoroughly free them from such sand, soil, or earth, and must be so certified by the duly authorized in-

spector of the country of origin; *Provided,* That sand, soil, or earth may be employed for the packing of bulbs and corms when such sand, soil, or earth has been sterilized or otherwise safeguarded in accordance with the methods prescribed by the Bureau of Agriculture and certified to that effect by the duly authorized inspector of the country of origin. The use of such sand, soil, or earth for packing materials other than bulbs and corms is not authorized.

All packing materials employed in connection with importations of nursery stock and other plants and seeds are subject to approval of the Bureau of Agriculture as to such use. Such packing materials must not previously have been used as packing or otherwise in connection with living plants, and, except for bulbs and corms, must be free from sand, soil, or earth and must be certified as meeting these conditions by the duly authorized inspector of the country of origin.

SEC. 9. *Plant materials held under quarantine.*—Any case, box, package, or other container containing plant materials which is being held subject to examination or determination as to final disposition, shall have attached to it a quarantine sign (Bureau of Agriculture Form No. 258) clearly indicating to employees of common carriers and the public that the container to which the sign is attached is being held subject to the rules and regulations promulgated by the Director of Agriculture. The movement or shipment of, or tampering with, any case, box, package, or other container containing plant materials having attached thereto a quarantine sign, which sign has been attached by the Plant Quarantine Inspector, is prohibited until such plant materials or the contents of such case, box, package, or other container have been inspected, the quarantine sign removed therefrom and the plant materials or container officially released by such an inspector.

SEC. 10. *Plant materials for which permit is not required.*—Fruits, vegetables, cereals, and other plant products designed for food purposes, or properly dried, and poisoned botanical specimens when free from sand, soil, or earth, may be imported, but subject to the conditions specified in sections 8 and 9 of these regulations.

SEC. 11. *Application for inspection of plant materials for exportation.*—All persons who intend to export plant materials must submit to the Bureau of Agriculture an application for inspection of the plant materials they desire to export, upon a form provided for the purpose (Bureau of Agriculture Form

No. 259) within a reasonable time before shipment so as to allow proper inspection.

SEC. 12. *Certification of plant materials for exportation; certificate of examination of plant materials for exportation.*—If the plants upon inspection are found to be free from parasitic fungi and injurious insects, a certificate (Bureau of Agriculture Form No. 260) shall be prepared and given by the plant quarantine inspector to the exporter to accompany the shipment. A copy of such certificate shall be filed in the Plant Quarantine Office. Plants which show the presence of injurious insects or parasitic fungi will be returned to the exporter without certification. The quarantine inspector shall prepare a certificate in duplicate (Bureau of Agriculture Form No. 261), one copy to be sent to the shipper and the other to be attached to the shipment. Recommendations may be made that such infested plants be destroyed or, where it seems justifiable, recommendations may be made for treating such plants at the expense of the exporter. Under no condition shall certificates of freedom from disease be given for plants which have been raised among other plants which are badly diseased or infested by insects. Caution must be used in issuing certificates and they must be given only after careful investigation of the previous history of such plants. Certification will not be made for plant materials of certain plant species intended for shipment to a country in which their entrance is absolutely prohibited.

SEC. 13. *Fees for fumigation and disinfection of plant materials.*—The following fees are hereby fixed for the fumigation or disinfection of all imported plant materials or parts thereof or of soil or any material whatsoever used for packing or covering same which is determined or suspected to be infected with injurious insects or plant diseases: Fifteen centavos (₱0.15) per lot requring one cubic meter or less of fumigation gas, and thirty centavos (₱0.30) per liter or less of disinfectant used.

No containers shall be broken, opened, or removed from the port of entry before the plant materials have been inspected and disinfected at the fumigation house of the Plant Quarantine Office.

SEC. 14. *Ports of entry.*—The inspection of incoming plant materials shall be made at the ports of Manila, Cebu, Iloilo, and Zamboanga. Plant materials shall not be admitted at any other port.

SEC. 15. *Incoming plant materials by mail.*—Plant materials entering this country through the post office shall be inspected

by the quarantine officials upon notification of the presence of such materials at the post office. The inspection for the purpose of determining whether such shipment should be passed or destroyed shall be the same as for materials coming through the customhouse. Inspection shall be made in the presence of either the consignee, a post-office official, or both.

SEC. 16. *Annulment of previous orders and regulations.*—All previous orders and regulations, or parts thereof inconsistent with the provisions of this order, are hereby revoked.

SEC. 17. *Penalty.*—Any person who violates any of the provisions contained in this administrative order shall, upon conviction thereof, be punished by a fine not exceeding one thousand pesos, or by imprisonment not exceeding six months, or by both such fine and imprisonment, in the discretion of the court.

(Sgd.) ADN. HERNANDEZ
Director of Agriculture

Approved, December 5, 1923:

(Sgd.) SILVERIO APOSTOL
Acting Secretary of Agriculture and Natural Resources

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF AGRICULTURE
MANILA

ADMINISTRATIVE ORDER No. 30

WHEREAS, the products of the abaca plant, *Musa textilis,* are among the principal exports of the Philippine Islands, the income from that source amounting to more than ₱44,000,000 annually; and

WHEREAS, there are known to exist in foreign countries insects injurious to, and fungi parasitic upon, such related plants as *Musa sapientum* and *Musa cavendishii* which might also affect the abaca plant;

THEREFORE, by authority of the provisions of Legislative Act No. 3027, approved March 8, 1922, the following regulations shall govern the importation of all plants of the genus *Musa* into the Philippine Islands:

SECTION 1. The importation of plants of the genus *Musa* or any unmanufactured parts of such plants is strictly prohibited; *Provided,* That importation through the port of Manila of small quantities of such plants may be permitted in order to secure better varieties for cultivation in this country, in accordance with section 2 of Administrative Order No. 29. Such importation must be made through the Director of Agriculture and must be held in plant quarantine in an isolation station until evidence is available showing that no injurious insects or parasitic fungi are present on such plants.

SEC. 2. Any importation of plants of the genus *Musa* or unmanufactured products of such plants in contravention of the provisions of this order shall be seized by the plant quarantine inspectors appointed by the Director of Agriculture, and shall be immediately exported or completely destroyed according to the decision of the Director of Agriculture or his authorized agents, the plant inspectors.

SEC. 3. Any person who violates any of the provisions contained in this administrative order shall, upon conviction thereof,

be punished by a fine not exceeding one thousand pesos, or by imprisonment not exceeding six months, or by both such fine and imprisonment, in the discretion of the court.

(Sgd.) ADN. HERNANDEZ
Director of Agriculture

Approved, December 5, 1923:

(Sgd.) SILVERIO APOSTOL
Acting Secretary of Agriculture and Natural Resources

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF AGRICULTURE
MANILA

ADMINISTRATIVE ORDER No. 31

WHEREAS, coconuts are one of the main economic plants of the Philippine Islands; and

WHEREAS, the products of the coconut plant are among the principal exports of this country, the income from such products amounting to more than ₱68,000,000 annually; and

WHEREAS, there are known to exist in foreign countries insects injurious to and fungi parasitic upon such plants, which do not yet exist in this country, and which might do serious damage if introduced;

THEREFORE, by authority of the provisions of Legislative Act No. 3027, approved March 6, 1922, the following regulations shall govern the importation of coconut plants or unmanufactured products of the coconut plant into the Philippine Islands:

SECTION 1. The importation of coconut plants or unmanufactured products of the coconut plant is strictly prohibited; *Provided,* That importation through the port of Manila of small numbers of coconut plants may be permitted for the purpose of promoting the knowledge of new and better varieties here, in accordance with section 2 of Administrative Order No. 29. Such an importation must be made through the Director of Agriculture and must be held in plant quarantine under isolation conditions and until it shall be demonstrated that no injurious insects or parasitic fungi are present upon such importation.

SEC. 2. Any importation of coconut plants or unmanufactured products of the coconut plant in contravention of the provisions of this order, shall be seized by the plant quarantine inspectors appointed by the Director of Agriculture, and shall be immediately exported or completely destroyed according to the decision of the Director of Agriculture or his authorized agents, the plant inspectors.

SEC. 3. Any person who violates any of the provisions contained in this administrative order shall, upon conviction

thereof, be punished by a fine not exceeding one thousand pesos, or by imprisonment not exceeding six months, or by both such fine and imprisonment, in the discretion of the court.

(Sgd.) ADN. HERNANDEZ
Director of Agriculture

Approved, December 5, 1923:

(Sgd.) SILVERIO APOSTOL
Acting Secretary of Agriculture and Natural Resources

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF AGRICULTURE
MANILA

ADMINISTRATIVE ORDER No. 32

WHEREAS, the products of the sugar cane, *Saccharum officinarum*, are among the principal exports of the Philippine Islands, the income from such export amounting to over ₱81,000,000 annually; and

WHEREAS, there are known to exist in foreign countries insects injurious to, and fungi parasitic upon, the sugar cane, which do not yet exist in the Philippine Islands; and

WHEREAS, should such insects and fungi be introduced into this country, they would be a factor tending to decrease the productivity of the sugar cane in this country.

THEREFORE, as a measure to protect the sugar-cane industry, by authority of the provisions of the Legislative Act No. 3027 approved March 8, 1922, the following rules shall regulate the importation of sugar cane into the Philippine Islands:

SECTION 1. The importation of sugar cane or any unmanufactured products of sugar cane is strictly prohibited; *Provided,* That importation through the port of Manila of sugar-cane plants or cuttings may be made through the Director of Agriculture, in accordance with section 2 of Administrative Order No. 29. Such importations are to be allowed only for the purpose of introducing new and better varieties of sugar cane, which it is believed may be cultivated to advantage in this country, and are to be held under quarantine at an isolation station until they have been shown to be free from all injurious insects and parasitic fungi.

SEC. 2. Any importation of sugar-cane plants or unmanufactured products of the sugar cane in contravention of the provisions of this order shall be seized by the plant quarantine inspectors appointed by the Director of Agriculture and they shall order the immediate exportation of such plants or their immediate and complete destruction, according to the decision of the Director of Agriculture or his authorized agents, the plant inspectors.

SEC. 3. Any person who violates any of the provisions contained in this administrative order shall, upon conviction thereof, be punished by a fine not exceeding one thousand pesos, or by imprisonment not exceeding six months, or by both such fine and imprisonment, in the discretion of the court.

(Sgd.) ADN. HERNANDEZ
Director of Agriculture

Approved, December 5, 1923:

(Sgd.) SILVERIO APOSTOL
Acting Secretary of Agriculture and Natural Resources

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF AGRICULTURE
MANILA

ADMINISTRATIVE ORDER No. 33

WHEREAS, rice, *Oryza sativa,* is the chief food of the people of the Philippine Islands, and the raising of rice plants forms the principal agricultural industry of the Philippine Islands; and

WHEREAS, injurious insects and parasitic fungi may exist in other rice producing countries which are as yet unexplored agriculturally; and

WHEREAS, such injurious and parasitic fungi if introduced into this country might seriously decrease the production of rice, thereby increasing the cost of production and the price to the customer;

THEREFORE, by authority of the provisions of Legislative Act No. 3027, approved March 8, 1922, the following rules shall regulate the importation of rice plants and untreated rice products into this country:

SECTION 1. The importation of rice plants, seeds, or untreated rice products is strictly prohibited; *Provided,* That importation through the port of Manila of such rice plants or rice products may be made for the purpose of improving the present rice varieties in this country, in accordance with section 2 of Administrative Order No. 29. Such importations must be made through the Director of Agriculture and must be held under quarantine in isolation until they have been shown to be free from all injurious insects and parasitic fungi.

SEC. 2. Any importation of rice plants or untreated products in contravention of the provisions of this order shall be seized by the plant quarantine inspectors appointed by the Director of Agriculture, who shall order to immediate exportation of such plants or their immediate and complete destruction, according to the decision of the Director of Agriculture or his authorized agents, the plant inspectors.

SEC. 3. Any person who violates any of the provisions contained in this administrative order shall, upon conviction thereof, be punished by a fine not exceeding one thousand pesos, or by imprisonment not exceeding six months, or by both such fine and imprisonment, in the discretion of the court.

(Sgd.) ADN. HERNANDEZ
Director of Agriculture

Approved, December 5, 1923:

(Sgd.) SILVERIO APOSTOL
Acting Secretary of Agriculture and Natural Resources

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF AGRICULTURE
MANILA

ADMINISTRATIVE ORDER No. 34

WHEREAS, there is known to exist in the Hawaiian Islands, Spain, France, Southern Italy, Sicily, Greece, Malta, Asiatic Turkey, Egypt, Cape Colony, Natal, British East Africa, Madagascar, Brazil, Argentina, and the northern states of Australia, an insect known as the Mediterranean Fruit Fly, *Ceratitis capitata,* which affects among other fruits the mango, the orange, the banana, the strawberry, carambola, bell pepper, papaya, carissa, sapote, lemon, coffee berry, persimmon, loquat, fig, mangosteen, tomato, alligator pear, and guava; and

WHEREAS, this injurious insect has not yet appeared in the Philippine Islands; and

WHEREAS, such fruits as named above constitute an important part of the food of the Philippine Islands and any injury resulting to them would affect not only fruit growers but consumers as well; and

WHEREAS, the foregoing injurious insect known commonly as the Mediterranean Fruit Fly, *Ceratitis capitata,* totally destroys any fruit which it may enter;

THEREFORE, by authority of Legislative Act No. 3027, approved March 8, 1922, the following regulations shall govern the importation of fruits and vegetables from the above-mentioned countries into the Philippine Islands:

SECTION 1. The importation of all fruits of the species listed herewith is strictly prohibited from Spain, France, Italy, Sicily, Greece, Malta, Asiatic Turkey, Egypt, Tunis, Algeria, Cape Colony, Natal, British East Africa, Madagascar, Brazil, Argentina, the Bermuda Islands, the Hawaiian Islands, and Australasia, with the exception of the States of Tasmania, South Australia, and Victoria in Australia. Importation from these last-mentioned states may be allowed provided that, with each shipment, a certificate be furnished from a properly authorized official of the Australian government guaranteeing that such

shipments originally emanated from the non-infested states of Tasmania, South Australia, and Victoria, that such shipments have not passed through any infested states and such a certificate shall give the last date of inspection of such non-infested regions. Fruits from these last-mentioned states accompanied by such a certificate will be subject to inspection for other injurious insects and parasitic fungi before being admitted. Fruits from non-infested countries will similarly be admitted subject to inspection for other injurious insects and parasitic fungi.

SEC. 2. Any importation of fruits of the foregoing species in contravention of the provisions of this order shall be seized by the plant quarantine inspectors appointed by the Director of Agriculture, who shall order the immediate exportation of such fruits or their immediate destruction according to the decision of the Director of Agriculture.

SEC. 3. Importation of fruits of the foregoing species from the quarantined countries may be made for promoting the fruit growing industry in this country, in accordance with section 2 of Administrative Order No. 29; *Provided,* That such importations be made in small amounts and through the Director of Agriculture, who will have such plants or seeds isolated under quarantine until they have been shown to be free from all injurious insects and parasitic fungi.

SEC. 4. Any person who violates any of the provisions contained in this administrative order shall, upon conviction thereof, be punished by a fine not exceeding one thousand pesos, or by imprisonment not exceeding six months, or by both such fine and imprisonment, in the discretion of the court.

(Sgd.) ADN. HERNANDEZ
Director of Agriculture

Approved, December 5, 1923:

(Sgd.) SILVERIO APOSTOL
Acting Secretary of Agriculture and Natural Resources

LIST OF FRUITS

1. Sapodilla (*Achras sapota*)
2. Acordia (*Acordia* sp.)
3. Sour sop (*Anona muricata*)
4. Sugar palm (*Arengia saccharifera*)
5. Breadfruit (*Artocarpus incisa*)
6. Carambla (*Averrhoa carambola*)
7. Ball kamani (*Calophyllum inophyllum*)
8. Bell pepper (*Capsicum* sp.)
9. Papaya (*Carica papaya*)
10. Dwarf papaya (*Carica quercifolia*)
11. Carisa (*Carissa arduina*)
12. Sapota (*Casimiroa edulis*)
13. Chinese inkberry (*Cestrum* sp.)
14. Star apple (*Chryssophyllum cainito*)
15. Damson plum (*Chrysophyllum oliviforme*)
16. Chinese orange (*Citrus japonica*)
17. Kumquat (*Citrus japonica*)
18. Tangerine (*Citrus nobilis*)
19. Mandarin (*Citrus nobilis*)
20. Lime (*Citrus medica limetta*)
21. Lemon (*Citrus medica limonum*)
22. Grape-fruit (*Citrus decumana*)
23. Shaddock (*Citrus decumana*)
24. Orange (*Citrus aurantium*)
25. Sour orange (*Citrus aurantium* var *Amara*)
26. Wampi (*Clausena wampi*)
27. Quince (*Cydonia vulgaris*)
28. Persimmon (*Diospyrus decandra*)
29. Loquat (*Eriobotrya japonica*)
30. Brazilian plum or Spanish cherry (*Eugenia brasiliensis*)
31. Rose apple (*Eugenia jambos*)
32. Burinam cherry (*Eugenia michelii*)
33. French cherry (*Eugenia uniflora*)
34. Fig (*Ficus carica*)
35. Mangosteen (*Garcina mangostana*)
36. Mangosteen (*Garcinia xanthochymus*)
37. Cultivated cotton (*Gossypium* sp.)
38. Mountain apple (*Jambosa malaccensis*)
39. Palm (*Lantanis plucuachulla*)
40. Tomato (*Lycopersicum esculentum*)
41. Liches nut (*Litchi chinensis*)
42. Mango (*Mangifera indica*)
43. Elengi tree (*Mimusops elengi*)
44. Mock orange (*Murraya exotica*)
45. Banana (*Musa* sp.)
46. Noronhia (*Noronhia emarginata*)
47. *Ochrosia* (*Ochrosia elliptica*)
48. Prickly pear (*Opuntia vulgaris*)
49. Passion vine (*Passiflora* sp.)
50. Avocado (*Persa gratisiima*)
51. Date palm (*Poenix dactylifera*)
52. Strawberry guava (*Psidium catteyanum*)
53. Sweet red and white lemon guavas (*Psidium guayava*)
54. Common guava (*Psidium guayava pomiferum*)
55. Waiawi (*Psidium guayava pyriferum*)
56. Peach (*Prunus persica*)
57. Nectarines (*Prunus persica* var. *nectarina*.
58. Apricot (*Prunus armeniaca*)
59. Plum (*Prunus* sp.)
60. Pomegranate (*Punica granatum*)
61. Apple (*Pyrus* sp.)
62. Pear (*Pyrus* sp.)
63. Sandalwood (*Santalum freycinetianum* var. *littorale*)
64. Eggplant (*Solanum melongena*)
65. Wi (*Spondias dulcis*)
66. Natal plum (*Terminalia chebula*)
67. Tropical almond or winged kamani (*Terminalia catappa*)
68. Bestill (*Thevetia nerrifolia*)
69. Grape (*Vitis labrusca*)

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF AGRICULTURE
MANILA

ADMINISTRATIVE ORDER No. 35

WHEREAS, there is known to exist in the Hawaiian Islands, Singapore, and other countries where pineapples are grown extensively, insects injurious to, and fungi parasitic upon, the pineapple, which do not yet exist in the Philippine Islands; and

WHEREAS, several of the insect pests injurious to, and fungi parasitic upon, pineapple plants are also injurious to, and parasitic upon, sugar canes; and

WHEREAS, if such insects and fungi were to be introduced into this country, they woud be a menace not only to our pineapple industry but to our sugar-cane industry also;

THEREFORE, by authority of the provisions of Legislative Act No. 3027, approved March 8, 1922, the following regulations shall govern the importation of all varieties of pineapple, *Ananas sativa,* into the Philippine Islands:

SECTION 1. The importation of pineappales or of any unmanufactured products of pineapple is strictly prohibited; *Provided,* That importation through the port of Manila in small quantities of pineapple plants may be made by or through the Director of Agriculture, in accordance with section 2 of Administrative Order No..29. These must be held in plant quarantine under isolation conditions until it shall be demonstrated that no injurious insects or parasitic fungi are present upon such importations.

SEC. 2. Any importation of pineapple plants or its unmanufactured products in contravention of the provisions of this order, shall be seized by the plant quarantine inspectors appointed by the Director of Agriculture and shall be either immediately exported or completely destroyed, according to the decision of the Director of Agriculture or his authorized agents, the plant inspectors.

SEC. 3. Any person who violates any of the provisions contained in this administrative order shall, upon conviction thereof, be punished by a fine not exceeding one thousand pesos, or by imprisonment not exceeding six months, or by both such fine and imprisonment, in the discretion of the court.

(Sgd.) ADN. HERNANDEZ
Director of Agriculture

Approved, December 5, 1923:

(Sgd.) SILVERIO APOSTOL
Acting Secretary of Agriculture and Natural Resources

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF AGRICULTURE
MANILA

ADMINISTRATIVE ORDER No. 36

WHEREAS, there exist in Japan, China, Australia, New Zealand, Oceania, Africa, Europe, South America, the British West Indies, Cuba, Central America and in some parts of the United States, dangerous diseases of bamboo, including bamboo smut, *Ustilago shiraiana,* which may be introduced into the Philippine Islands by importation of bamboo plants, or cuttings thereof capable of propagation, including all genera and species of the family *Bambusae,* from the above-named countries; and

WHEREAS, if such diseases were introduced into the Philippines they would become a menace to our bamboo;

THEREFORE, by authority of the provisions of Legislative Act No. 3027, approved March 8, 1922, the following regulations shall govern the importation of all genera and species of the family *Bambusae:*

SECTION 1. The importation of bamboo plants or any unmanufactured parts thereof is strictly prohibited; *Provided,* That importation in small quantities of bamboo plants may be made by the Director of Agriculture for experimental and scientific purposes.

SEC. 2. Any importation of bamboo plants or unmanufactured parts thereof in contravention of the provisions of this order, shall be seized by the plant quarantine inspectors appointed by the Director of Agriculture and shall be either immediately exported at the expense of the importer or completely destroyed, according to the decision of the Director of Agriculture or his authorized agents, the plant inspectors.

SEC. 3. Any person who violates any of the provisions contained in this administrative order shall, upon conviction thereof, be punished by a fine not exceeding one thousand pesos, or by imprisonment not exceeding six months, or by both such fine and imprisonment, in the discretion of the court.

(Sgd.) ADN. HERNANDEZ
Director of Agriculture

Approved, December 5, 1923:

(Sgd.) SILVERIO APOSTOL
Acting Secretary of Agriculture and Natural Resources

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF AGRICULTURE
MANILA

ADMINISTRATIVE ORDER No. 37

WHEREAS, the products of tobacco plant, *Nicotiana tabaccum*, are among the principal exports of the Philippines, the income from that source amounting to more than ₱13,000,000 annually; and

WHEREAS, there are known to exist in foreign countries insects injurious to, and fungi parasitic upon, the tobacco plant, which do not yet exist in this country; and

WHEREAS, such injurious insects and parasitic fungi would seriously decrease the amount of tobacco produced in the Philippine Islands;

THEREFORE, by authority of the provisions of Legislative Act No. 3027, approved March 8, 1922, the following regulations shall govern the importation of all plants of *Nicotiana tabaccum* into this country:

SECTION 1. The importation of all plants or seeds of the species *Nicotiana tabaccum* or of any untreated products of such plants is strictly prohibited; *Provided,* That the importation through the port of Manila of such plants, seeds, or untreated products may be permitted for the purpose of securing better or more productive varieties for cultivation in this country, in accordance with section 2 of Administrative Order No. 29. Such importations must be made through the Director of Agriculture and must be held under quarantine in isolation, until they have been shown to be free from injurious insects and parasitic fungi.

SEC. 2. Any importation of such tobacco plants or untreated products in contravention of the provisions of this order shall be seized by the plant quarantine inspectors appointed by the Director of Agriculture, and they shall order the immediate exportation of such plants or products or their immediate and complete destruction, according to the decision of the Director of Agriculture or his authorized agents, the plant inspectors.

SEC. 3. Any person who violates any of the provisions contained in this administrative order shall, upon conviction thereof, be punished by a fine not exceeding one thousand pesos, or by imprisonment not exceeding six months, or by both such fine and imprisonment, in the discretion of the court.

(Sgd.) ADN. HERNANDEZ
Director of Agriculture

Approved, December 5, 1923:

(Sgd.) SILVERIO APOSTOL
Acting Secretary of Agriculture and Natural Resources

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF AGRICULTURE
MANILA

ADMINISTRATIVE ORDER No. 38

PROVIDING FOR THE DESTRUCTION OF PLANTS INFECTED WITH ABACA HEART-ROT AND ROOT-ROT DISEASES

WHEREAS, there exists in certain parts of the Philippine Islands the diseases generally known as abaca heart-rot and root-rot;

WHEREAS, adequate measures should be adopted to prevent the spread and to effect the control of these diseases;

THEREFORE, by authority of the provisions of Act No. 3027 the diseases generally known as abaca heart-rot and root-rot are hereby declared to be dangerous plant diseases and shall be dealt with as hereinafter described:

SECTION 1. Whenever either abaca heart-rot or root-rot or both are known to exist in any locality of the Philippine Islands, the Director of Agriculture or his authorized agent will inspect all abaca plants in that locality, to mark in a suitable manner all plants ascertained to be affected by the diseases, and to issue a notification in writing to the owners, lessees, or person incharge of abaca plantations, or plants advising them that disease or diseases exist among their plants and to indicate to them what plants are diseased.

SEC. 2. Whenever the Director of Agriculture or his authorized agent shall have issued a notification in accordance with the provisions of section 1 hereof, it shall be the duty of the owner lessee, or person incharge of the abaca plantation or plants having the disease or diseases to destroy every affected plant by cutting it down or digging it up, if necessary, and completely burning the crown and other infected parts thereof.

SEC. 3. Failure to destroy affected trees within a period of fourteen days from the date of receipt of written notification shall be considered *prima facie* evidence of an endeavor to evade the obligation imposed by virtue of this order and shall render the owner, lessee, or person incharge of abaca plantations or plants liable to the full penalties herein provided.

SEC. 4. Any person who, after being duly notified in writing by the proper authority, as herein provided, fails or refuses to comply with the requirements of this order shall upon conviction suffer the penalties provided in section 13 of Act No. 3027, which is a fine not exceeding one thousand pesos (₱1,000), or imprisonment not exceeding six months, or both such fine and imprisonment, in the discretion of the court.

SEC. 5. In order to carry out the provisions of this order, the Director of Agriculture or any person acting in his behalf shall have access at all times into and upon any land occupied by any abaca plant or plants for the purpose of inspection.

SEC. 6. General Orders No. 52 and 55 of the Bureau of Agriculture, respectively, are hereby repealed.

(Sgd.) ADN. HERNANDEZ
Director of Agriculture

Approved, December 5, 1923:

(Sgd.) SILVERIO APOSTOL
Acting Secretary of Agriculture and Natural Resources

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF AGRICULTURE
MANILA

ADMINISTRATIVE ORDER No. 39

REGULATING THE ERADICATION OF COCONUT BUD-ROT

WHEREAS, there exists in certain parts of the Philippine Islands the disease commonly known as coconut bud-rot;

WHEREAS, this disease is a menace to the agricultural interests of these Islands; and

WHEREAS, adequate measures should be adopted to prevent the spread and to effect the control of the said disease;

THEREFORE, by authority of the provisions of Legislative Act No. 3027 the disease commonly known as coconut bud-rot is hereby declared to be a dangerous plant disease and shall be dealt with as hereinafter prescribed:

SECTION 1. Whenever an outbreak of coconut bud-rot is known to exist in any locality of the Philippine Islands it shall be the duty of the Director of Agriculture or his authorized agent to inspect all coconut trees in that locality, to mark in a suitable manner all trees ascertained to be affected by the disease, and to issue notification in writing to the owners, lessees, or persons incharge of coconut plantations, groves, or trees advising them that the disease exists among their trees and indicating to them what trees are diseased.

SEC. 2. Whenever the Director of Agriculture or his authorized agent shall have issued notification in accordance with the provisions of section 1 hereof, it shall be the duty of the owner, lessee, or person incharge of the coconut plantation, grove, or trees where the disease exists to destroy every affected tree by cutting down and completely burning the crown and other infected parts thereof.

SEC. 3. Failure to destroy affected trees within a period of fourteen days from the date of receipt of written notification shall be considered *prima facie* evidence of an endeavor to avoid the duties imposed by virtue of this order and shall render the owner, lessee, or person incharge of coconut plantations, groves,

or trees liable to the full penalties provided by section 13 of Legislative Act No. 3027, which is a fine not exceeding one thousand pesos, or imprisonment not exceeding six months, or both such fine and imprisonment, in the discretion of the court.

SEC. 4. In order to carry out the provisions of this order, the Director of Agriculture or any person acting in his behalf shall have access at all times into and upon any land occupied by any coconut tree or trees for the purpose of inspection.

(Sgd.) ADN. HERNANDEZ
Director of Agriculture

Approved, December 5, 1923:

(Sgd.) SILVERIO APOSTOL
Acting Secretary of Agriculture and Natural Resources

CURRENT NOTES—FIRST QUARTER

By P. J. Wester

FORCING TROPICAL FRUITS

In the past the seasons of the temperate fruits and a few tropical ones like the citrus fruits, the pineapple, and avocado has been prolonged by planting early and late ripening varieties and by the use of cold storage.

In the Philippines the smoking of the mango trees to force them into fruiting out of season is a well recognized cultural practice, but one that, curiously enough, has never been applied to other fruit trees, though in all probability other species could be forced to fruit at irregular intervals with equal facility. That this has not been already done is due, no doubt, to the fact that no one ever thought of doing so notwithstanding that it has been repeatedly seen that the mango responds to this treatment. As a matter of fact in the Azores the pineapple is also forced into fruiting by smoking the plants, a circumstance which so far as I know has never been recorded in horticultural literature.

In those islands pineapple growing is a considerable industry, but the plants are not grown in this open fields but in houses, under glass. A writer in the *National Geographic Magazine*, Vol. XXXV, 1919, p. 533, states that the smoking process is the result of an accidental discovery made many years ago.

"The furnace in one of the hothouses began to smoke and filled the entire house with fumes. The planter believed that his crop was ruined, but discovered later, to his surprise, that all his plants not only matured more quickly, but also simultaneously. Since then it has been learned that pineapples requiring several years to mature under the old system will show signs of bearing forty days after being smoked, and then mature more evenly.

"The furnaces used for smoking are filled with green grass or foliage and allowed to smoke three nights in succession."

It is probable that a large number of tropical fruits, if not all, can be brought into fruiting at will by smoking, barring of

course in instances where the pollination or setting of the flowers is adversely affected by rains.

Fumigation of the trees under tents has for many years been a standard practice as a means of control of various insect pests in the citrus orchards in Florida and California. Perhaps the time is not so far distant when these will put to use in forcing the trees to flower and fruit out of season. Certainly experiments in that direction would seem worth while. In lieu of the glass houses used in the Azores low canvas tents would probably answer the purpose for pineapples.

Again, a recent article contributed by *Science Service* to a recent number of *Science* would tend to show that the forcing of trees into fruiting may be effected merely by a hypodermic injection of ether. To quote as follows:

STIMULATION OF PLANTS BY ETHER

No longer will useful plants be allowed to sleep out their long winter sleep if a discovery just announced to *Science Service* by Professor David Lumsden of the Federal Horticultural Board, becomes the common property of nurserymen, amateur and professional gardeners, and even farmers. For he has found that if given a "shot of dope," either by the inhalation or hypodermic method, they may be awakened as if by an alarm clock and set to their work of growing and producing flowers or fruit for the pleasure or profit of man.

The drug used in his experiments was the common ether of the hospital operating room, but instead of putting his plant subjects to sleep *it woke them up.* They liked it and seemed to thrive after just one treatment. For example, some plants were taken from outdoors in midwinter when they had to be dug from the frozen ground with picks, were given an overnight ether debauch and the next morning shoots of an average length of one eight of an inch had sprouted. Kept indoors they continued to grow and flowers were produced weeks in advance of the usual blossoming season.

Roses were taken from the frozen ground and given a hypodermic injection of the same drug. Not only did they sprout and grow but, more important still to the indoor gardener, they were immune to all the ordinary plant diseases that make indoor rose culture a practical impossibility except in large greenhouses. Professor Lumsden has had roses in February, just six weeks from the time the plant was given its stimulating injection.

In the hypodermic method, Professor Lumsden made use of that sometimes formidable weapon, a woman's hat pin. With this a puncture about a quarter of an inch deep was made at the base of the stem of the plant where it joins the root. Then an ordinary hypodermic needle was introduced and half of one cubic centimeter of ether injected. This is the method which was generally used with woody plants such as roses or lilacs.

One of the more important applications of this whole process, according to Professor Lumsden, is that using either method of drugging the plant, every single latent bud or shoot is brought to life. This is not nature's way, as usually only one of three or four ever grows. This may mean much in the culture of plants such as dahlias or potatoes which are grown from tubers. If every latent bud on these tubers could be made to grow they could be cut into smaller pieces and expense of seed saved. What is more, Doctor Lumsden believes that the plants would be more vigorous.

For he is working now to see if these ether treatments, especially the hypodermic sort, do not impart a lasting vigor to the plant, enabling it to resist disease. His experiments with roses strongly indicate this. If they are confirmed, ether "shots" will with plants take the place of the various forms of vaccinations to which the would-be-healthy humans are now subjected.

Finally, there is a mystery in this whole affair which science may some day solve, but of which it now knows little. Ether temporarily stimulates and then profoundly depresses all animal life. With plant life, in moderate doses, it is apparently *all stimulation* with no depression and no injurious after effects, but instead *a life-long increase in strength and endurance.* If science can learn why this is so, much light will be thrown, Professor Lumsden says, upon the secrets of physiological growth.

THE INTRODUCTION OF NEW FOODS AND FOOD CROPS

The Dasheen, a superior variety of the Yautia, *Xanthosoma sagittifolium,* an important root crop in the West Indies, similar to the Gabi, *Colocasia esculenta,* but more productive and more palatable, was introduced into the Southern States about 20 years ago, since which time the U. S. Department of Agriculture has waged a ceaseless propaganda to extend its uses in the United States. Being a new crop and a new food, the Dasheen occupies much the same position in the United States as adlay, the new grain, occupies in the Philippines.

The problems that confront the introducer of new food plants and new foods is so well put and the matter is so pertinent to the Philippines, where 111 species of new food plants have been introduced since 1900, that the following is quoted from a circular letter about dasheens which is being broadcasted by the U. S. Department of Agriculture and received here in the last mail. The statements made here about the dasheen are especially applicable to adlay:

DASHEENS

The dasheen, as the reader may already know, is a delicious, wholesome, and nutritious vegetable. Its food value is not a matter of theory; it has been proved by exhaustive scientific tests.

202840——6

New things, however, take hold slowly. Most of us know that the tomato, which now ranks very high in the economic importance among garden products, was long grown merely as an ornamental. Even within the memory of people now living, its fruits were considered actually poisonous. And the potato, long established in favor with the peoples of many nationalities, traveled a thorny path to its present position of distinction. The opposition to it in France at one time is said to have been so severe that the government was petitioned to suppress its cultivation.

These facts suggest that merit is not always enough to overcome speedily the popular prejudice or conservatism concerning little-known foods. Dasheens are now grown commercially in the southern United States and numerous people have already made them an important feature of their menu, but education and publicity are needed to extend their use. We who know the value of the dasheen must see that it does not suffer the delay that these other valuable vegetables did in winning general appreciation and popularity.

It is to be expected that a good many people who try the dasheen for the first time will reject it—either because of its newness or, what is more likely, because a failure to prepare the vegetable properly spoils it for them. So it is essential that dasheen growers and others who have learned its true value do what they can to popularize it. Once the merits of the dasheen are generally konwn, the industry will take care of itself; but in the beginning it needs encouragement, and help.

Habit, it will be agreed, largely determines what we choose for our daily food. We can form the habit of using dasheens at least occasionally. In the matter of these starchy foods, some of us have the bread habit and eat a great deal of bread; others have the potato, sweet-potato, corn-grits, or rice habit, and get our starch mainly from one of these foods. Where dasheens (and other taros), tropical yams, cassava, and the like are common, the eating of one or more of them becomes habitual. *We must spread the dasheen habit!*

Now that dasheens are being grown in our southern States, let not only the growers, but all other people who can get them—and who like good food, like variety, and are interested in seeing the development of a new agricultural industry—begin the occasional use of this valuable new food. The grower himself can add to the variety of his food by using dasheens, while he saves on the purchase of potatoes, for potatoes are not only high-priced in the South, as a rule, but are not equal in food value to the dasheen; potatoes contain more water.

Get the dasheen habit! Study different ways of preparing dasheens until you find at least two or three simple methods that are entirely satisfactory. Make a point of serving them hot from the stove, as soon as done. The dasheen, like other vegetables, can be prepared attractively if interested attention is given to it. Also, it is not more difficult to spoil in the preparation than many other foods. When properly handled, baked, fried, or made into crisps or salad, and so forth—there is no more palatable vegetable than the dasheen. *And the taste for it grows!*

When you have learned how to prepare dasheens acceptably for your own family, demonstrate to your neighbors who do not know how; and if they have the requisite conditions, get them to grow dasheens for their own use—and perhaps for sale. And when you have visitors, whether from far or from near, who do not know the dasheen or who have not

learned to eat it, do not fail to give them an opportunity to eat it properly prepared. *The taste is the test!*

Then remember the tomato and the potato, and help to spread the knowledge of this less-known but equally valuable vegetable, the dasheen.

NEW COFFEE COUNTRY

The new English colony, Kenya, in tropical East Africa, which one sees frequently mentioned in English publications, but which is barely known in America, is heralded as a promising coffee country in a recent issue of *Tropical Life* (London). Coffee grown in Kenya is reported to have sold in London for from £ 70 to 90 per ton.

According to *Tropical Life* one district alone in Kenya has "possibly one million acres of land, virgin soil suitable for growing high class coffee." Apparently there has been quite a "rush" to this new coffee country, as land values have increased from 3,000 to 5,000 per cent in six years. There are already 4,000 acres in coffee and an annual increase of 2,000 to 3,000 acres in plantations is anticipated. One hundred fifty tons of coffee was produced last year, shipped from Mombasa.

It is noted with considerable surprise that Arabian is the coffee planted. Considering the deadly work effected by *Hemileia vastatrix* on this coffee in Ceylon, India, Java and the Philippines, which disease is also present in East Africa one wonders what will happen to the Kenya coffee plantations.

I take this opportunity to recommend *Tropical Life* to our readers as covering tropical agriculture throughout the world and in all its branches as few other publications to-day. Mr. H. Hamel Smith, the editor, is also well known for his excellent books: The Fermentation of Cacao; Coconuts—The Consols of the East; and Soil and Plant Sanitation on Cacao and Rubber Estates.

POLYEMBRYONI IN THE COCONUT

The coconut, *Cocos nucifera,* is normally monoembryonic, though now and then two and sometimes three plants grow from one coconut.

In the Cebu industrial fair in 1921, the author found on exposition two coconut palms one of which had the extraordinary number of 13 plants of various sizes growing from one nut, while another palm at the same exhibit had seven plants growing out of one nut. Among those growing 13 plantlets from one nut the tallest plant was about 3 meters high while the smaller ones did not measure more than about 0.5 meters in height.

The Philippine

Agricultural Review

VOL. XVII SECOND QUARTER, 1924 No. 2

A QUARTERLY PUBLICATION

ISSUED IN ENGLISH BY THE
BUREAU OF AGRICULTURE

The Government of the Philippine Islands
Department of Agriculture and Natural Resources

Subscription rates: ₱2 (Philippine currency) or $1 (U. S. currency) per annum in the Philippine Islands and the United States and territories.
$2 (U. S. currency) per annum in foreign countries.

MANILA
BUREAU OF PRINTING
1924

(Entered at the Post Office at Manila as second-class matter)

Pateros, where the Philippine duck industry is supposed to have started. The small fenced yards are typical in the duck region

THE PHILIPPINE

Agricultural Review

VOL. XVII SECOND QUARTER, 1924 No. 2

TABLE OF CONTENTS

		Page
1.	The Duck Industry in the Philippines, by Carlos X. Burgos	87
2.	Manufacture of Copra in the Philippine, by P. J. Wester	101
3.	Some Observations on Root Grubs (*Leocopholis irrorata*) in the Philippines and Suggestions for their Control, by Faustino Q. Otanes	109
4.	The Storage and Curing of Batangas Mandarin Oranges, by Jose de Leon	120
5.	The Use of Fungicides in the Philippines, by Gaudencio M. Reyes and N. B. Serrano	127
6.	The Use of Fertilizers and Green Manuring on the Farm, by Aniano Elayda	134
7.	Disposal of Carcasses of Animals That Have Died of Anthrax and of those Dying of Undetermined Diseases	140
8.	Poultry Notes	142

ILLUSTRATIONS

PLATE I. Pateros, where the Philippine duck industry is supposed to have started. The small fenced yards are typical in the duck region .... *Frontispiece*

Facing page—

II. Duck shelter where ducks are kept at night for protection and to make sure that no eggs are laid outside during the night 88

III. Native ducks in their yards. The low inside fence on the right is to keep the snail feed in low water 90

IV. The eggs are sorted and counted before they are placed in the baskets called *kaings* 90

V. Where formerly ducks' eggs were transported in flat slow-going *bancas*, now they are transported by Ford trucks and at cheaper rates 92

VI. (*a*) Splitting coconuts and removing the meat from the shells at the Polo Coconut Plantation 104

(*b*) Copra air-drying shed on the Montenegro Coconut Plantation 104

VII. (*a*) Concrete alley in which the meat is removed from the coconuts on the Bioos Coconut Plantation 104

(*b*) Racks for copra trays in drying shed on the Bioos Coconut Plantation 104

VIII. (*a*) Sun-drying copra at the Polo Coconut Plantation 106

(*b*) Trays for sun-drying copra stacked for the night at the Polo Coconut Plantation 106

IX. (*a*) The Craft drier, Zamboanga 106

(*b*) The Craft copra drier. The trays pulled out and charged with coconuts for drying 106

X. (*a*) The Patalon copra drier. Near view of arch in course of construction 108

(*b*) Interior view of the Patalon copra drier with copra in process of drying. Furnace door to the left; base of chimney to the right 108

XI. (*a*) The Patalon copra drier in course of construction 108

(*b*) Bodega housing the Patalon copra drier 108

XII. Photograph of *Leucopholis irrorata* showing different stages, slightly enlarged; (1) grubs or larvæ, (2) pupæ, (*a*) ventral aspect, (*b*) dorsal aspect, (3) adults, (*c*) female, (*d*) male 110

XIII. (*a*) Stems of sugar-cane-root system damaged by grubs of *L. irrorata*. Note also holes or cavities on stems made by the grubs 110

(*b*) Mango seedlings killed by the grubs. Note the total absence of roots of some of the seedlings 110

XIV. (1) Eggs of *Leucopholis irrorata*, (*a*) natural size (*b*) enlarged 114

(2) Ventral view of anal segment of full-grown grub. Note the anal slit, the hooked setæ directed inward 114

TEXT FIGURES

Page

FIGURE 1. Some forms of snails commonly used for feeding the ducks also a fresh water clam 90

2. Native incubators used at Pateros, Rizal 90

3. Kawa on kiln for heating the palay used in the incubators 91

4. Ground plan of the Patalon copra drier, less the grill 106

5. Diagram indicating what fertilizer materials may and may not be safely mixed. The dark lines unite materials which should never be mixed the double lines those which should be applied immediately after mixing, and the single lines those which may be mixed at any time 139

THE DUCK INDUSTRY IN THE PHILIPPINES

By CARLOS X. BURGOS, *Animal Husbandman*

The prevalent opinion among the investigators of this Philippine industry is that duck raising was started at Pateros and Tagig by Chinese traders who settled there before the discovery of the Islands by the Spaniards. This region was well-adapted to the industry, for food could be had easily by the ducks themselves just going after it and the source of the food was then free from contamination, until too many ducks were raised. The towns had natural drainage facilities that kept them sanitary. Due to these natural advantages the industry grew rapidly and became the thriving success we find it to-day.

From these places the ducks were distributed to other towns of Rizal and to Laguna and other nearby provinces. The Philippine Census of 1918 gives the following as the towns that have over 2,000 ducks:

LAGUNA PROVINCE	
Cabuyao	19,205
Pila	12,256
Santa Cruz	9,804
Los Baños	4,642
Biñang	3,642
RIZAL PROVINCE	
Pateros	15,320
Tagiig	10,158
Binangonan	4,260
Jalajala	4,149
BULACAN PROVINCE	
Hagonoy	14,908
Paombong	9,046
PAMPANGA PROVINCE	
Masantol	21,846
Macabebe	2,249

The ducks are principally raised for their eggs which are either sold as *balut, penoy,* or fresh. The *balut* is an egg that has been incubated, with the chick allowed to develop usually up to the 18th or 19th day, though many incubate them only to the 16th or 17th day. It is then boiled hard and sold principally

in Manila and at the railroad stations near the egg centers. The retail price for each egg is on the average 8 centavos. The *penoy* is an infertile egg that has been under incubation for about 13 days which is the usual time when the eggs are tested. These are cooked and sold in the same way as *balut* but at a lesser price, usually 5 centavos each. The fresh eggs are sold in Manila where they are used by bakeries, restaurants, and the public in general for culinary purposes. These eggs consist mainly of thin-shelled eggs, supposed to be infertile or to have weak germs.

THE NATIVE DUCK

The native ducks are commonly called either *tagig* or *itik*. They are much smaller than the Indian Runner ducks but they lay comparatively large eggs. They are satisfactory layers and are hardy; otherwise, raising them would not have withstood the test of becoming a commercial industry. In color, they vary as no pains have been taken for their improvement, but the black with white neck predominate, with the grays, second.

In a pen that is under experiment at Alabang, the following results have been obtained:

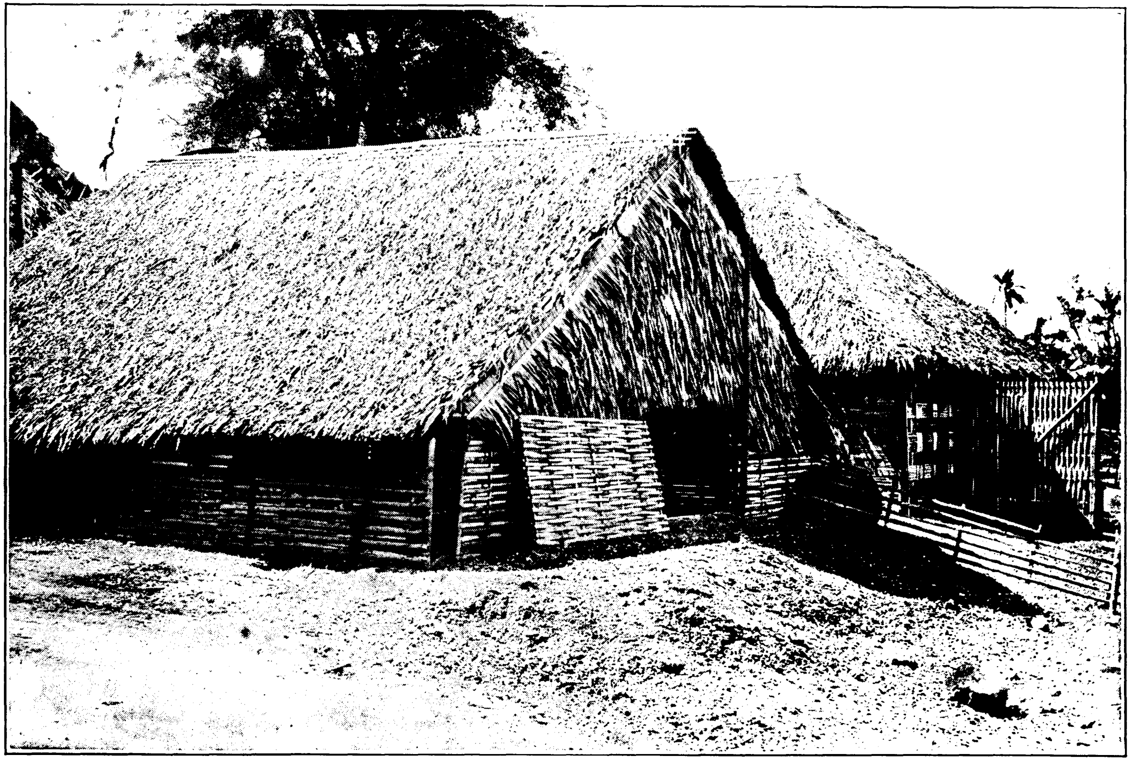
Month	Number of ducks	Number of eggs laid	Average number of eggs laid per duck	Amount of feed consumed in kilos	
				Palay	*Susô*
1923					
May	20	268	13.4	18.75	928.0
June	20	472	23.6	16.92	1,126.4
July	20	437	21.9	19.68	1,146.8
August	20	313	15.7	23.76	1,088.4
September	19	256	13.5	21.60	1,152.0
October	19	249	13.1	22.32	1,190.4
November	18	166	9.2	23.04	1,075.2
December	18	120	6.7	23.40	1,113.6
Total	....	2,281	117.1	169.48	8,838.8
Average per month	....	285	14.64	21.18	1,104.9

(Due to the constant moving of the house by the river on account of the unavoidable rise of water during the rainy weather and the subsequent floods, this record was not as high as it should have been, but at this rate, they can be easily credited as laying individually 150 to 180 eggs a year.)

A comparative weighing of Pekin, Indian Runner, and native ducks was recently taken at Alabang, and the figures are:

Kinds of ducks	Drakes	Female ducks	Eggs
	Grams	*Grams*	*Grams*
Pekin	2,787	2,700	90
Indian Runner	1,878	1,697	78.85
Native	1,240	1,146	67.05

To distinguish the adult male from the adult females, requires a little experience that is easily acquired by observing the flock



Duck shelter where ducks are kept at night for protection and to make sure that no eggs are laid outside during the night

for a few minutes. The males are somewhat bigger and have several curly feathers in the tail. The female's tail feathers lie flat. The females have a low voice and quack while the males have a shrill voice of higher pitch.

MANAGEMENT AND CARE

At Pateros and Tagig, the ducks are cared for in groups averaging 100 birds with a ratio of one male to nine females. They are penned up in long yards about 10 by 4 meters and have access to running water where they swim and eat the *susô* given them. At night, they are kept in a duck house, that is 4 by 4 meters. This house is built low, of cheap light materials, usually nipa and bamboo. The floor consists of plain clay, piled up and packed down and raised higher than the surrounding ground by at least 8 to 10 centimeters. The floor is covered with rice hulls or straw and cleaned of the droppings every morning. As soon as it becomes filthy and damp, the practice is to place this litter in the sun to dry and in the meantime to replace it with new material. The fences of the yards up to the present have been made up of split bamboo only, and the height has been 30 to 40 centimeters. This makes it possible for one to go from pen to pen over the fences.

Most of the eggs are laid during the night on the floor and are gathered early before cleaning time. The ducks seem to have no particular choice as to where they lay their eggs but oftentimes a number will be found nesting together in a corner. Now and then a duck becomes broody but only for a short time.

FEEDS AND FEEDING

The ducks are let out early in the morning and fed with palay (unhulled rice) and sometimes whole corn. However, when *susô* is plentiful, the grains are not fed. The *susô* (*Vivipara angularis,* Miller and Melania sp.) is piled up partly in the water and partly on the bank of their swimming place and is therefore accessible to them at all times. In the afternoon, when *susô* is not plentiful, they are again fed with palay. About one and a half gantas (1 ganta=3 liters) of palay is consumed by 100 birds.

The *susô* is the greatest factor in egg production and without it the duck raisers are at a loss for a proper substitute that will make the ducks lay the normal number of eggs. They have not found any so far. Duck raisers make it a point to study which bed of snails increase egg production and they gather the materials from these good beds until exhausted.

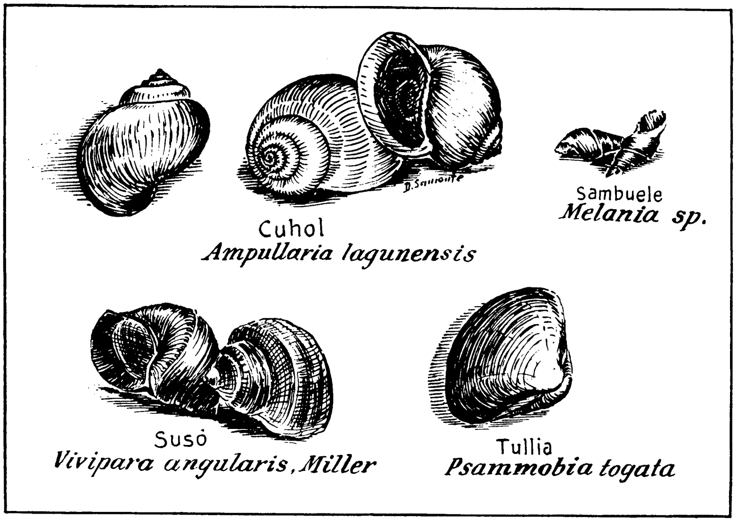


FIG. 1. Some forms of snails commonly used for feeding the ducks also a fresh water claim.

INCUBATION OF EGGS

Although the hatcheries are not in stone *camarins* like those of Canton, the methods of hatching are very similar. The house is generally a one-room affair and usually consists of bamboo and nipa, built so that there will be no drafts. This is called

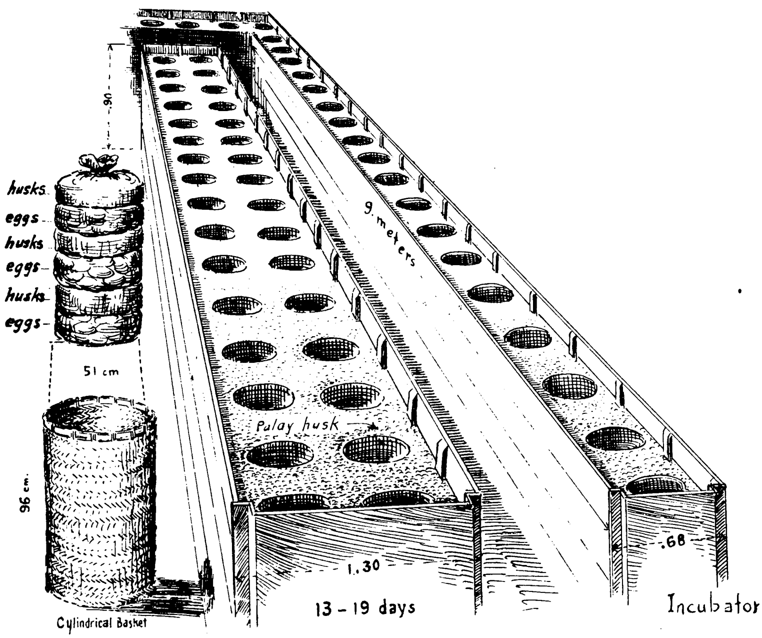
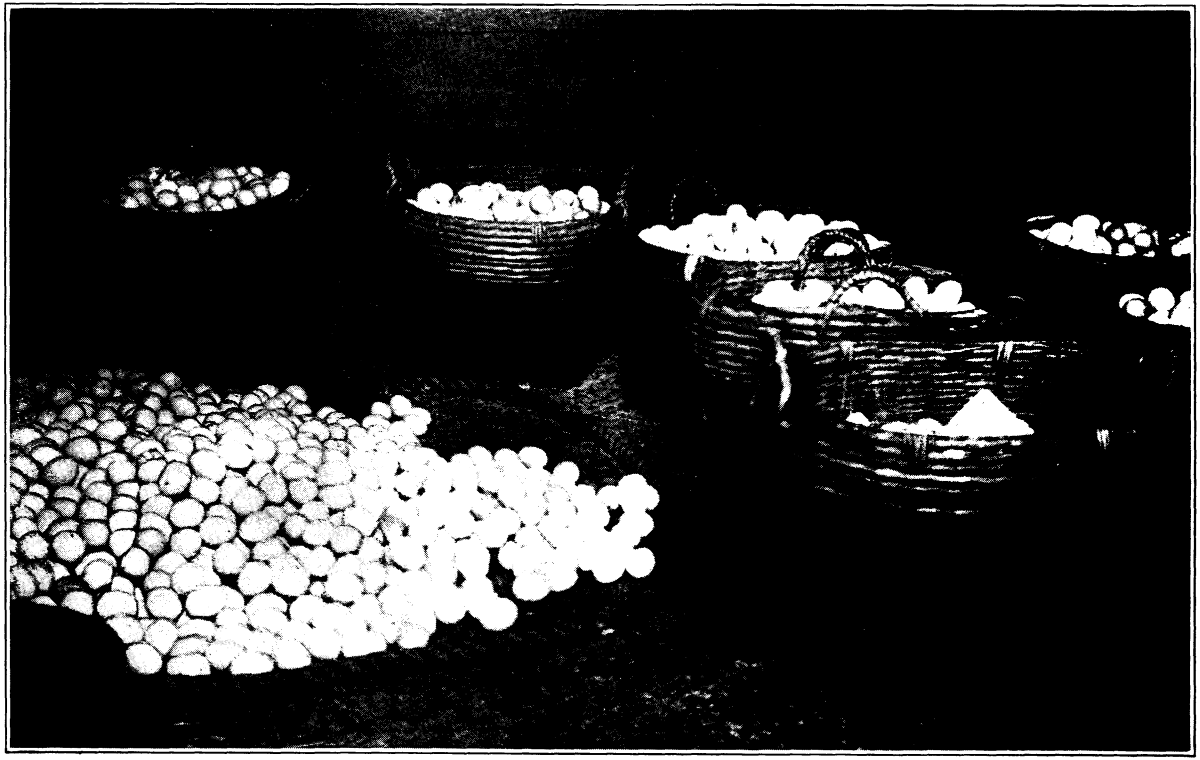


FIG. 2. Native incubators used at Pateros, Rizal.

Native ducks in their yards. The low inside fence on the right is to keep the snails feed in low water



The eggs are sorted and counted before they are placed in the baskets called "kaings"

balutan or hatcher. The incubators consists of cylindrical baskets about 50 centimeters in diameter and about 80 centimeters deep. Around each basket rice hulls are packed to serve as insulators.

Only fresh, strong-shelled eggs are selected for incubation. These are usually first placed in the sun until sufficiently hot when they are bagged in *sinamay* cloth, 125 eggs to the bag. The bottom of the basket is filled with palay that has been heated to about the natural temperature of a fowl. On this a bag of eggs is placed so that the eggs lie even and this is topped by another bag of heated palay; then another of eggs and another of palay,

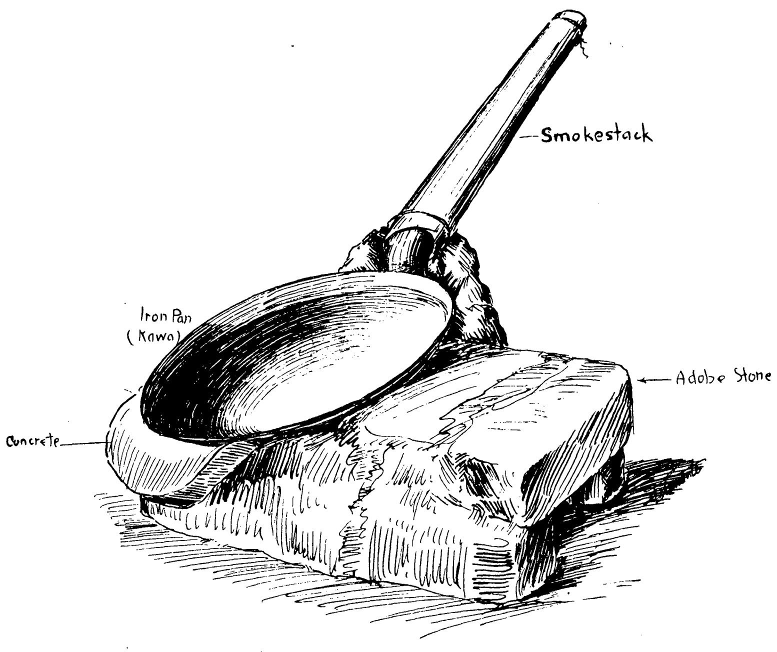


FIG. 3. Kawa on kider for heating the palay used in the incubators.

until the basket is filled with ten layers of eggs. On top of these are put two bags of heated palay. To insure even temperature throughout the incubation period, the palay is heated every morning and afternoon in a *kawa* (pan). The experienced hand of the caretaker is the only index used to determine the heat, which is usually arount 39° C. to 40° C. From the tenth to the thirteenth day, the eggs are tested by candling and the infertile ones, separated for sale. The eggs intended for hatching are separated on the twentieth day and placed on a table covered with paper, mats, and cloth, and two and one-half centi-

meters of rice hulls. This table is called the "empolladora," or *cehohan.* It is about one meter high, one and two-third meters wide and several meters long, depending on the capacity of the hatchery. The eggs are put on this table side by side and are then covered with two or three cotton sheets, according to the weather. A black sheet is preferred by the caretakers.

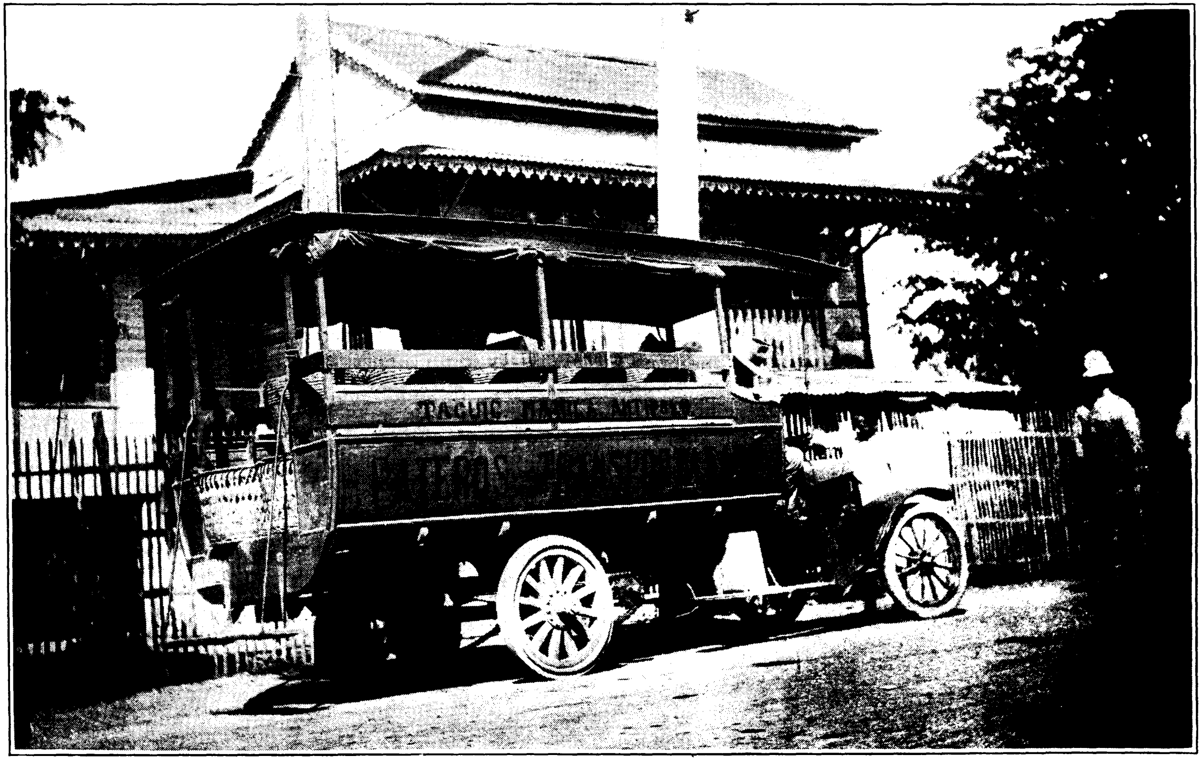
The hatchers (empolladora) are kept dark and have a cotton sheet on the sides to keep the temperature constant. The floor is covered 2 or 3 inches deep with rice hulls.

The eggs are turned daily until they are ready to hatch. When any signs of putrefaction show, as often happens, the spoiled eggs are immediately taken away from the bunch. After 20 days' incubation no extra heat is applied to the eggs, as it is claimed that the embryos generate enough heat to keep themselves alive, and if properly covered to prevent loss of heat, the eggs can be expected to hatch on the twenty-eighth to the thirtieth day.

Of the eggs that are put in these hatchers, the owners claim that 60 per cent become ducks or *balut,* 5 per cent get rotten, 30 per cent *penoy* and 5 per cent *ukbo* which mean eggs with developed dead germs. (The *ukbo* is prepared for eating purposes by the men in charge of the hatcheries.)

CARE OF THE DUCKLINGS

The newly hatched are not fed for 24 to 36 hours after hatching. After that they are placed under the house of the caretaker where a place is arranged for them. They are fed in a shallow pan or from a clean smooth surface with soft-boiled rice five times a day and are given water in another or the same pan. When about 3 days old, they are divided into 2 groups, male and female. The method of distinguishing one from the other is by putting the small finger in the region of the crop, then pressing lightly on the back. This process forces out in the vent side the distinguishing mark of each. Most of the males are sold either to the people that raise them for the market or directly to fanciers in the market. The ducklings intended to be raised for breeding are put in groups of about 500 with 10 per cent males. When available, they are fed *gamo-gamó* (flying termites common in the Islands), and more often, shrimps. This feed is given mixed with rice after the fifth day. They are put in the sun for a while every day, especially after about the fifteenth day, when they are allowed to swim for a while. This time for swimming is never extended too long lest they overexercise and die. When about one month old, they are trans-



Where formerly ducks' eggs were transported in flat slow going "bancas," now they are transported by Ford trucks and at cheaper rates

ferred into a larger enclosure and they are fed with palay and pounded *susô*. They are thereafter allowed to stay in the water as long as they like. At the age of four to four and one-half months, they are put into permanent breeding pens, and it is claimed that they will lay as early as this, if properly cared for, although the majority can not be expected to begin laying until about seven months of age. The percentage of deaths up to four months old is estimated at 40 per cent under this treatment.

DISEASES

The duck, compared to the chicken, is free from disease but once it becomes sick there is very little chance for recovery.

Coccidiosis.—This disease was observed at Alabàng in 1917. The symptoms were complete loss of appetite, gradual emaciation and weakness as evidenced by the staggery gait of those affected. The feathers become ruffled, as if the fowls were afflicted with intestinal trouble, and at times they rolled on their backs. Very few lived through the disease, the duration being two to five days. Almost one-half of the flock died.

On post mortem examination, white nodules were seen in the walls of the intestines and also a few on the liver. The lungs were very pale and shrunken.

Remedy.—None of the treatments given the diseased ducks ways successful, so the only remedy left was prevention. The sick ducks were separated and put in a distant place and the duck house and yards were thoroughly cleaned from rubbish and thereafter disinfected with a strong solution of creoline. Potassium permanganate crystals were added to the drinking and swimming water to color it pink, and Abbot's carbolate tablet was given with the mash feed. In spite of this treatment, many cases still continued to appear. When the *susô* feed was withheld, the disease slowed down until it stopped.

Sore eyes.—Ducklings one to three weeks old at times become affected with sore eyes.

The symptoms are loss of appetite and closed eyes. Sometimes the ducklings can not open their eyes without help. The treatment is washing the eyes with boric acid solution and the giving of soft mash feed with boiled rice.

Diarrhea is sometimes observed among the mature ducks. There are two kinds, the acute and the chronic. The symptoms are the same as for chickens. When there is acute diarrhea in a flock as many as five will be found dead in the morning. The treatment that we have given is one sulpho-carbolate tablet per

two birds dissolved in a little water and given with the mash feed. As a preventive, the rest of the flock is also given sulphocarbolate in their drinking water at the rate of one tablet per half liter.

SOME SUGGESTIONS FOR THE IMPROVEMENT IN THIS SYSTEM OF RAISING DUCKS

1. It is believed that fertility of eggs could be increased by reducing the proportion of males and females to 1 : 6 or 1 : 8, instead of 1 : 9, or by using only young active and vigorous ducks.
2. Making conditions sanitary should be part of the daily routine work.
3. A brooder house well protected from drafts with spacious partitions should be built and the number of ducklings in each group limited to 100 at the most—and better 50—so that the ducklings will not trample on each other and that all may get their share of food. This would materially reduce the percentage of deaths.
4. The yards and duck house should be made large to keep the birds in good health.
5. More variety in the grain and mash feeds would bring better results. A mixture of *tiqui-tiqui,* ground corn and ground mongo, given daily as a moist mash to accustom the ducks to this feed, should help greatly in egg production when snail feed becomes short. If shrimps or fish scraps are available to add to the mixture the egg production would not be greatly affected by the shortage of *susô* feed. About the time the typhoon season is due, begin to feed a certain amount of the following or an equivalent mixture, so that there will be no abrupt and complete change in the diet if there is a shortage of snails:

   6 parts tiqui-tiqui of good quality.
   2 parts ground corn.
   1½ parts ground mongo.
   ½ part small dried shrimps.

   When there is no snail feed available give as much as 2 to 3 deciliters of this per duck per day in two feedings. *Always give it in moist form.*
6. There should be a systematic culling of old and other undesirable ducks every three months. This will mean a reduction in the feed consumed and a proportional increase of eggs per duck. Those with well-developed vents should have preference over others. Watery eyes are signs of a weak constitution and birds so affected should be separated from the flock. Toe-mark-

ing of ducks, or some other system, should be adopted to help in telling the old from the young if hese happen to get mixed, or if allowed to go in the same run.

7. Those who do not have and can not afford to build or buy an incubator, may use setting hens to hatch duck eggs provided precautions are taken to free the hens and nests from lice and mites. It is claimed by some that ducks raised by this method are the best for breeding stock. Ducklings are easy to raise at any time before the rainy season. At Alabang Stock Farm, December and January are the best hatching months.

8. In Canton some duck raisers keep their ducks in a floating duck house, which is also the dwelling of the caretaker and his family. This house is not stationary but is moved to fields along the river where the ducks may get feed without expense from the owner. They feed mostly on snails, grass, and weed seeds.

Ducks relish finely chopped grass and green vegetables, if accustomed to them, and these should be given as part of their daily ration, particularly when their yards have become bare of vegetation. If these are not available, tender banana trunks can be chopped fine and fed to them instead though they would not be as good. However, the use of green feeds to excess is not recommended for it might decrease egg production due to its low food value. It also makes their flesh flabby. Ducks intended for the table need not be fed green feed two weeks before killing.

9. Plenty of shade should be provided for both young and adult ducks.

10. If there is no natural running water where the ducks may swim, a pond should be built for them as swimming seems to stimulate egg production. All duck raisers agree that it increases the percentage of fertile eggs.

11. Some people keep ducks and other fowls together in the same yard and pen. This practice is not considered good because of constant quarreling among them.

12. The practice of determining temperature by feeling can not be as accurate as a tested thermometer. It is now time to adopt at least such more modern methods as are most needed.

13. The establishment of a *susô* reservation where the kinds of *susô* may be studied, preserved and bred for distribution, would be a good thing for the duck industry.

PERTAINING TO OTHER DUCKS

The Indian Runner and Pekin ducks are two introductions of the Bureau of Agriculture. The former was imported on April

2, 1917, from the United States, and the latter on June 12, 1923, from Cheefoo, China.

The Pekin is at present the most popular breed of ducks in the United States for the production of meat. The Indian Runner duck is the most popular for the production of eggs and is considered the White Leghorn among the ducks. Up to the present they have been under acclimatization tests only, but experiments have been started to determine their qualities in comparison with those of the native ducks. Steps have also taken to induce duck raisers to try these breeds for crossing with native ducks and for testing their adaptability to the native feeds and the local system of management. With the exception of a preliminary experiment of the Bureau of Agriculture which seems to show that the native ducks are better layers than the Indian Runner ducks, nothing very definite can be said. However, from what has been observed, there is promise to improve at least the size of the native ducks as well as the size of their eggs. (A copy of the results of the experiment comparing the Indian Runner duck with the native duck as an egg producer is appended at the end of this article.)

The Muscovy duck is known in these Islands as "pato real" or "bibi" and many small breeders prefer them as pets on account of the fact that they become broody and are much larger, weighing from three to four and one-half kilos. They are considered by many as belonging to an entirely different species. The hybrids with native ducks known to the writer lay infertile eggs but some claim they are sometimes fertile. The most distinguishing characteristic of these ducks is that the face has a red, rather rough, bulging skin and the males do not have the curly feathers of the other breeds. The objection to the Muscovies is that they fly far at times and get lost, and they are not very good layers. However, they require very little care and can be raised successfully by the average farmer, as they are good foragers. The writer has also known of hybrids between this breed and the native geese but he has never known them to lay eggs.

The "Baliwis" (*Anas Luzonica*, Fraser) is the wild Philippine duck that is seen in small swarms in Laguna de Bay (Bay lake) at times and can be hunted in many of the islands, especially Marinduque, Luzon, and Mindoro, where water abounds. In conformation, it resembles the Muscovy but it is very much smaller. The writer has been able to tame these birds but never was able to propagate them. The color is dark brown on the back and light chestnut on the ventral side, with a glossy green spot on each wing. The bill and feet are greenish black.

There is another duck, the "papan" (*patong-dagat*), found in large flocks on fresh water marshes and lakes. It is smaller than the "baliwis" but the hunters prefer them as they are easily killed. They abound in Lake Laguna. In general, the color of the neck is white, the back is bluish black, the ventral side is buff gray with black spots. The bill and feet are dark green.

ACKNOWLEDGMENT

The author wishes to acknowledge the suggestions given by Mr. Alfonso Tuason, Chief of the Animal Husbandry Division of the Bureau of Agriculture; Dr. B. M. Gonzalez, Mr. Eczequiel Alcasid, Mr. Vicente Allarey, and Mr. J. G. Guevara, in the preparation of this article.

APPENDIX

EXPERIMENT

COMPARISON OF THE EGG PRODUCTION OF INDIAN RUNNER DUCKS AND NATIVE DUCKS

The present work is a study of the egg production of the Indian Runner ducks and of the native ducks on the shore of Bay Lake, near a river in the barrio of Alabang, Muntinlupa, Rizal. It was begun May 1, 1923.

The experiment has not as yet been concluded and no exhaustive discussion on the subject will be made, however, the description of the way the experiment is conducted and the primary results are reported herein.

Twenty-five Indian Runner ducks, 5 males and 20 females, all about one year and a half old, and twenty-five native ducks of about the same age, were used. They were divided into two lots according to their breed and were housed in cogon shacks of the same size near the river. Each house is provided with an enclosure in the river where they can swim. Every time there is a rise of water in the lake the houses and ducks are transferred to a higher place.

Both ducks received the same kind of feed (palay and *susô*) and practically the same treatment. The number of eggs produced and the amount of feed consumed are recorded daily.

The following tables show the results obtained from May to December, 1923:

TABLE I.—*Egg production of Indian Runner ducks*

Month	Number of ducks		Number of eggs laid per month	Average number of eggs laid per duck.
	Male	Female		
May	5	20	336	16.80
June	5	20	246	12.35
July	4	20	264	13.20
August	4	19	210	11.05
September	4	18	149	8.28
October	4	17	140	8.24
November	4	17	138	8.12
December	4	17	120	7.06
Total			1,604	85.10
Average			200.5	10.64

TABLE I.—*Egg production of Indian Runner ducks*—Continued

Month	Amount of feed consumed and cost				Total cost	Remarks
	Palay	Cost	Snails	Cost		
	Kilos		*Kilos*			
May	23.04	₱1.84	1,139.2	₱14.81	₱16.65	The cost per kilo of snails is ₱0.013 and that of palay is ₱0.08.
June	16.92	1.35	1,126.4	14 64	15.99	
July	19.68	1.57	1,164.8	15.14	16.71	
August	23.76	1.90	1,088.4	14.15	16.05	
September	21.60	1.73	1,152 0	14.98	16.71	
October	22.32	1.79	1,587.2	20.63	22.42	
November	23.04	1.84	1,356.4	17.63	19.47	
December	23.40	1.87	1,113.6	14 48	16.35	
Total	173.76	....	9,728.0	....	140.35	
Average	21.72	....	1,218.0	....	17.54	

TABLE II.—*Egg production of native ducks*

Month	Number of ducks		Number of eggs laid per month	Average number of eggs laid per duck
	Male	Female		
1923				
May	5	20	268	13.4
June	4	20	472	23.6
July	4	20	437	21.9
August	4	20	313	15.7
September	4	19	256	13.5
October	4	19	249	13.1
November	4	18	166	9.2
December	4	18	120	6.7
Total	....	....	2,281	117.1
Average	....	....	285.1	14.64

Month	Amount of feed consumed and cost				Total cost	Remarks
	Palay	Cost	Snails	Cost		
	Kilos		*Kilos*			
May	18.76	₱1.50	₱928.0	₱12.06	₱13.56	
June	16.92	1.35	1,126.4	14.64	15.99	
July	19.68	1.57	1,164.8	15.14	16.71	
August	23.76	1.90	1,088.4	14.15	16.04	
September	21.60	1.73	1,152.0	14.98	16.71	
October	21.42	1.79	1,190.4	15.48	17.27	
November	23.04	1.84	1,075.2	13.09	15.32	
December	23.40	1.87	1,113.6	14.48	16.35	
Total	169.48	....	8,838.8	....	128 45	
Average	21.18	....	1,104.9	....	16.06	

TABLE III.—*Relative weights of Indian Runner ducks and native ducks eggs*

Breed	Number of eggs	Weight	Average weight per egg	Remarks
		Grams	*Grams*	
Indian Runner ducks	6	498.6	83.1	Average for Indian Runner ducks 78.85 grams.
Do	6	445.3	74.6	
Native ducks	6	357.0	59.3	Average for native ducks 67.05 grams.
Do	6	448.8	74.8	

TABLE IV.—*Incubation*

Breeds	Date set	Number of eggs set	Number of infertile eggs	Per cent of infertile	Number of dead germs	Number died in shell	Number of hatch	Per cent of hatch	Remarks
Native ducks	June 19	80	7.0	8.75			47	65.76	Natural, after one week of artificial incubation.
Indian Runner ducks	do	50	21.0	42.00			5	17.24	
Native ducks	Nov. 10	118	11.0	9.32	14	41	52	48.59	Native artificial incubation at Pateros.
Indian Runner ducks	do	121	16.0	13.22	63	35	7	6.09	

Table III shows that the Indian Runner ducks eggs are heavier than the native duck eggs. The average weight of the Indian Runner eggs is 78.85 grams; while that of the native duck eggs is 67.05 grams, a difference of 11.80 grams, in favor of the Indian Runner ducks. Table IV shows that the percentage of fertility and of hatch of the native duck eggs are higher than those of the Indian Runners.

In the first set the percentage of hatch of Indian Runners was 17.24 while that of the native ducks was 65.76; and in the second set that of the Indian Runners was 6.09 and that of the native, 48.59. This shows a very low vitality for the Indian Runner ducks.

It must be taken into account that the Indian Runner ducks are not completely acclimatized and are not quite used to the native feed.

MANUFACTURE OF COPRA IN THE PHILIPPINES

By P. J. WESTER

Coconut growing is one of the most important industries in the Philippines. In 1922, 422,284 hectares were planted to coconuts with a total production of nearly one and a half billion nuts, of which the greater part were made into 351,151 tons of copra, valued at ₱44,000,000 in round figures. Coconut products ranked third in importance among our industries, being exceeded only by rice and sugar. Among the exports they held the first place with copra, copra meal, and coconut oil exports totaling ₱62,100,000. The number of trees planted has about doubled in the last ten years.

While the Philippines is one of the principal producers of copra in the world, it is a distressing fact that the product from here fetches the lowest price. It is estimated that as compared with the price of Ceylon copra, the Philippine planters in 1922 sustained an economic loss of about nine million pesos. This amount would have more than paid for all the meat and dairy products imported in the same year. It is almost equal to the total exports of embroidery, hats, and lumber. This enormous loss is due to the poor grade of copra produced, largely because of insufficient and faulty drying and handling.

Somewhat more than one-half of the copra was *tapahan* dried in 1922, and a correspondingly smaller part was sundried. Less than one-half of one per cent was dried on modern driers

Efforts have been made to induce the planters to improve their methods of drying, and good driers have been installed on a few plantations the owners of which were not satisfied with the low prices offered for copra made by the native methods. But little or no improvements have been effected among the rank and file. The individual holdings are small as a rule, and exporters and millers are not willing to pay an advanced price for superior copra in small lots. Under such circumstances, and where a majority of the planters are indifferent to the production of better copra, there is little or no inducement for those who realize the losses incurred because of the poor grade of copra produced to improve their own output. Unless concerted action is taken by the small planters of a district to induce

improved methods of drying copra by a majority of the producers on a sufficiently large scale to demand recognition by exporters and local millers of copra we need expect little or no improvement either in the copra grades or the prices paid for the product until the production on the large plantations shall have reached such a figure that their copra is shipped out in, say, one thousand ton lots. Then the ambitious small planter will not be so dependent upon the action of his more indifferent neighbors as he is now.

Where the climate permits, the copra is dried in the sun in the Philippines. However, in the most prominent coconut regions, as in Laguna and Tayabas and Mindanao, the sky is often so overcast and rains are so frequent that sun-drying is out of the question. Here the copra is dried in the *tapahan,* which is an oblong pit on the top of which is built a grill of bamboo, leaving one end of the pit open, at the bottom of which a fire is made. The raw coconut meat is placed on the grill, the fire is lighted, and the hot air and smoke passes upward through the grill and so dries (and smokes) the meat. The copra made in this way is commonly insufficiently and unevenly dried, and as a matter of course, becomes dark and discolored from the smoke. In other words, it is of inferior quality, and consequently fetches a low price.

At the present writing, in the local market *tapahan* dried copra is sold at from ₱10.62 to ₱11 per picul, the sun-dried copra sells at ₱11.62 to ₱11.75, and exgodown copra at from ₱12 to ₱12.25 per picul (1 picul=63.25 kilos). Comparing now only the domestic grades, with an average yield of 24 piculs of copra to the hectare per annum, this represents an annual loss of ₱22.88 per hectare per annum owing to the use of the *tapahan* drier. Since on an area of 200 hectares this amounts to ₱4,576, the installation of a Patalon drier—which presently will be described—at a cost of ₱2,800, including bodega, would pay for itself and leave a profit of ₱1,776 the first year.

On most coconut plantations in the Philippines the nuts are first husked by hand, and subsequently split before drying, but at the Polo, Bioos, and the Montenegro plantations, Dumaguete, Oriental Negros, splitting the unhusked nut with a broad axe or a heavy bolo, after which the meat is pried out with a curved knife, has been adopted as being a more economical procedure, as it eliminates the cost of husking.

At the Polo Plantation, the expense of hauling the nuts from the field to the drier has been still further reduced by splitting

the collected nuts in the fields, and removing the meat from them on portable platforms (Plate VI–*a*) which are carried from one block to another as the work proceeds, after which the coconut meat is bagged and brought to the drier in wagons or trucks. The husks are scattered in the field, and plowed under. In this way nothing is removed from the field except the coconut meat, which is a very light drain upon the fertility of the soil, the productivity of which, it would appear, could thus be maintained unimpaired for many years without the aid of fertilizer.

Attempts were made a few years ago by the Bureau of Science to dry copra by exposing the coconut meat to sulphur fumes, and while this attempt failed, it was found that the sulphuring of the meat was advantageous in that it prevented the formation of molds and hastened the drying of the meat. The field experiments were conducted at Polo where the sulphuring of the coconut meat has become a part of the routine in the copra manufacture for more than a year, as it is also on the Montenegro plantation.

The sulphuring box, as built by Mr. Detrick, is 275 centimeters long, 125 centimeters wide, and 210 centimeters high. It has a false bottom, made of slats through which the fumes can pass easily, about 15 centimeters above the floor, under which there is space for a shallow tin pan containing the sulphur.

The gunny bags containing the coconut meat brought from the fields are piled in the box and the sulphur is ignited, after which the door is closed. The coconut meat is exposed to the sulphur fumes for 4 hours, after which it is run through a cutter to chop the meat into a smaller size, which permits uniform and more rapid drying of the copra than if the meat was dried as it comes removed from the nuts in large pieces.

The sulphuring box which is air tight, of course, has been built at a cost of less than ₱40. With sulphur selling at 40 centavos per kilo, the meat from approximately 3,000 nuts can be treated at one time at a cost of less than five centavos ($0.025 U. S. currency) per picul of dry copra, one and a half to two kilos of sulphur being required for each treatment.

Sulphuring is recommended as a cheap, effective, and practical preventative for molds affecting copra and should be applied to the fresh meat before drying. It does not injure the quality of the coconut oil, and hastens the drying of the copra.

The rainfall in southeastern Negros is not so abundant as in most other coconut regions in the Philippines. Sunshiny

days are frequent, and the atmosphere is drier than commonly found in other coconut districts. Taking advantage of these circumstances, Mr. Jesus Montenegro has constructed two novel air drying sheds in which the copra is air dried without exposure to the sun. One of these sheds is shown in Plate VI–*b*. It is built throughout of material found on the plantation, the drying floors being made of split bamboo, spaced so as to allow free circulation of air. There are four drying floors, a meter apart, one above the other, the first floor being about 1.5 meters above the ground. Lattice work of split bamboo canes attached to the posts on the outside protects the copra from being molested by dogs and other animals. Awnings made of palm leaves are fastened to the house on the windy side to prevent driving rains from reaching the drying coconut meat during wet weather. According to Mr. Montenegro, sulphured coconut meat will dry in 6 to 8 days in this shed during ordinary weather.

Much copra is also sun and air dried on the Bioos and the Polo Coconut Plantations, also located in the southeastern part of the Island of Negros.

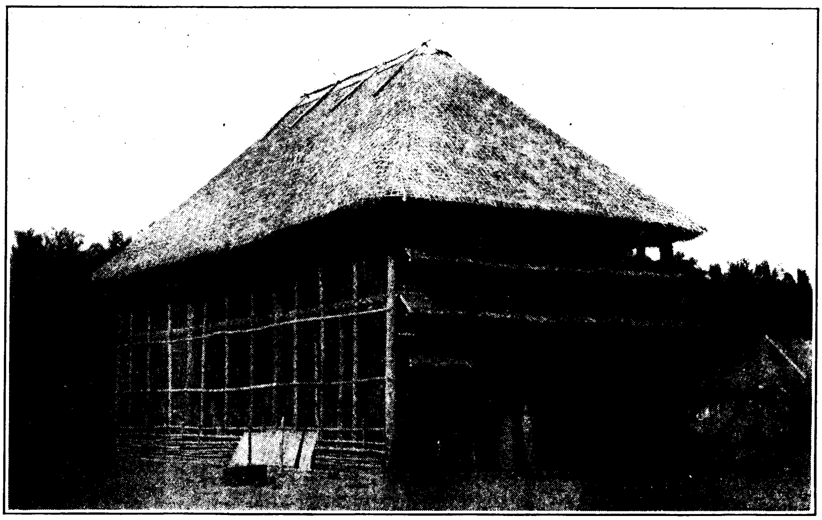
At the Bioos Plantation, owned and managed by Mr. Henry Fleischer, the coconuts are hauled to the drying plant, and piled up in a long heap on one side of what may be called an alley made of concrete. The nuts are then thrown into the alley where a gang of men split the nuts in two with a broad axe on blocks of wood. Another gang of men pry out the meat from the split nuts with a curved knife, and throw the husks and shells on the other side of the alley.[1] (See Plate VII–*a*.)

The coconut meat is subsequently spread on trays, 90 by 1.80 centimeters, with bottoms of $\frac{3}{4}$-inch poultry netting or woven bamboo, which are placed on a concrete floor in the drying yard in front of a long shed. In the shed is a series of racks on which to place the trays at night and when showers threaten in the day time or where the copra is air dried (Plate VII–*b*.). Each tier has five racks, 42 centimeters apart, each with space for two trays. Between each tier of racks there is a free space of 1.25 meters. The concrete floor in the shed is raised above the ground and slopes downward and outward, and the shed is enclosed with woven wire fencing to prevent depredations of dogs, etc. A similar shed is also in use at Polo except that the trays are slightly larger, 90 by 1.95 centimeters, and that each tier has six racks instead of five. Since the trays are of uniform size, at Polo they are sometimes stacked up and covered

---

[1] As stated on another page at the Polo Plantation, the coconuts are split and the meat removed in the field. (Plate VI-*a*.)

(*a*) Splitting coconuts and removing the meat from the shells at the Polo Coconut Plantation



(*b*) Copra air-drying shed on the Montenegro Coconut Plantation

with small portable "rooflets" made of palm leaves as shown in Plate VIII–*b* at night and during showers, to protect the copra from moisture.

A Grinnell drier has been installed at the Bioos Plantation. It gives satisfactory service, but is too expensive and difficult to operate to warrant installing on any but very large plantations.

To meet the popular demand for a cheap, easily operated drier, suited to the needs of the small planters, Mr. W. R. Craft, Zamboanga, built a chamber of concrete, open on one side for the insertion of the trays, containing three tiers of large trays, with four trays to each tier, and a frame with tray rails in front on which the trays were supported when pulled out in the course of loading and unloading. This chamber with trays quite resembles a large filing case. In a pit under the chamber was placed an old boiler which served as a furnace, and the heat radiating therefrom passed upward through the trays loaded with copra.

Mr. Craft's contrivance was so simple and inexpensive and easy to operate that three driers of this type were built within a short time in Zamboanga, with the modification that no frames were built in front of the driers as shown in the original Craft drier (See Plate IX–*a*). Its principal drawback is the uneven drying of the copra, which dries more rapidly near the furnace than at the top.

This difficulty has been overcome by the invention of a tray shifting mechanism, devised by Mr. H. J. Detrick, manager of the Polo and Pamplona Coconut Plantations, Dumaguete, Oriental Negros, the most distinguishing feature in the Polo copra drier, described by the inventor in this *Review*, Vol. XVI, No. 4, 1923.

The Polo copra drier was built in 1922, and has been in operation at the Polo Plantation for nearly two years, where it has given such satisfactory results that other driers of the same type will be installed as more coconut trees come into bearing. It is a distinct advance over its prototype, the Craft drier, is of simple construction, and has no intricate machinery to get out of order, is inexpensive, and is easy to operate. The Polo copra drier combines all the advantages of the Craft drier with its own distinct features. Everything considered, it is well adapted to conditions peculiar to the Philippines.

Like the Craft drier, the Polo drier is a chamber containing several tiers of trays, placed above a boiler. The firing is done in a furnace in front of the boiler into which the fire and smoke

passes on the way to the chimney. The heat radiates from the boiler and passes upward through the drying chamber. For a more detailed description of this drier, see the article by Mr. Detrick previously referred to.

In the 5-section drier described by Mr. Detrick which was constructed at a cost of ₱1,100, exclusive of the bodega, about 950 kilos (15 piculs) of copra is turned out every 24 hours. In other words, it has sufficient capacity to take care of the coconut crop of 200 hectares, calculating 100 trees to the hectare, with an average crop of 60 nuts per tree per annum.

Still another drier has been developed by Mr. Otto Galle, manager of the Patalon Coconut Estate, Zamboanga, Mindanao.

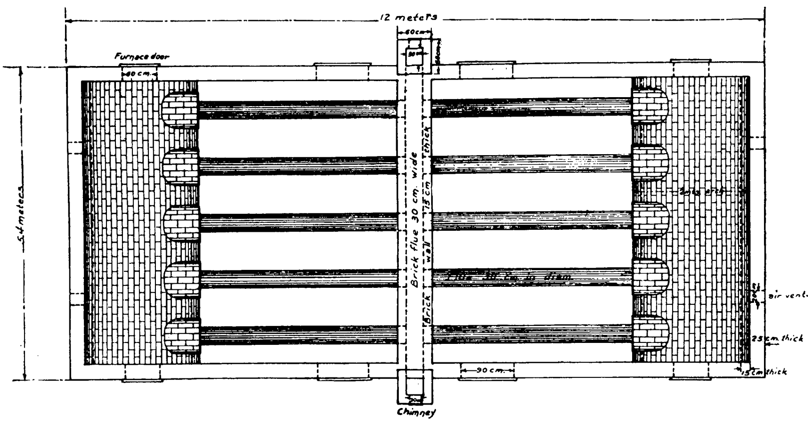


FIG. 4. Ground plan of the Patalon copra dries, less the grill.

For all practical purposes, it is an adaptation of the *tapahan* drier, and consists of a drying grill built above an arch made of stone or brick enclosed within a wall of brick. The arch serves as a furnace from which the heat radiates, and confined by the brick wall surrounding the furnace, the hot air passes upward through the grill, and so dries the coconut meat placed thereon.

The advantages of this drier are:

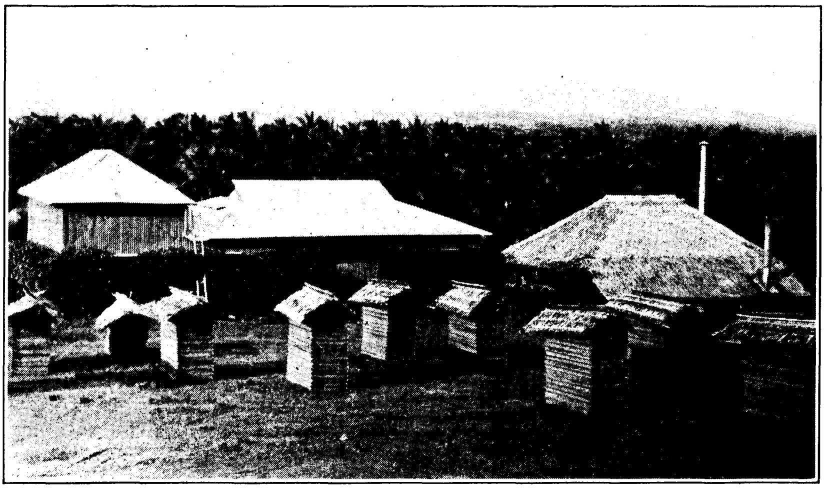
1. It can be made of material ordinarily found on the plantation, except for cement, furnace doors, damper, sheet iron for the shutters for the air vents, spikes and nails, and sheet iron for the flues, and these latter can be made of bricks if desired.

2. It can be constructed by the planter with the aid of ordinary labor found on the plantation.

3. With no mechanism to get out of order, it can be operated by labor ordinarily found on coconut plantations.

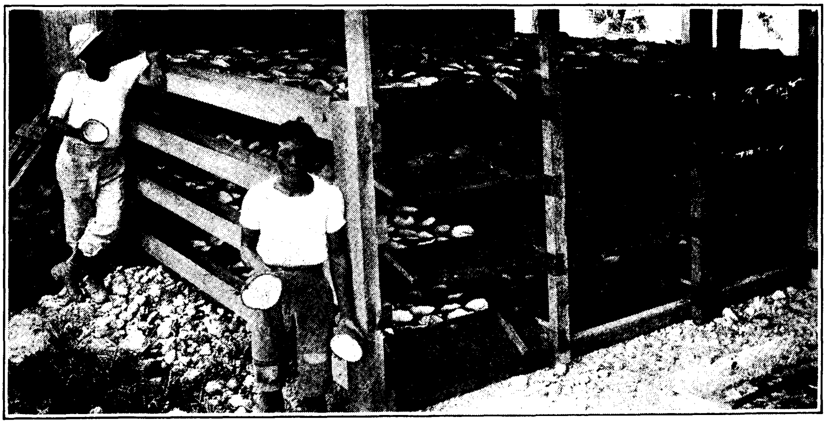
4. Constructed almost entirely of bricks, there is practically no danger from fire, and in the event of fire, the grill can be cheaply and easily replaced.

(*a*) Sun-drying copra at the Polo Coconut Plantation



(*b*) Trays for sun-drying copra stacked for the night at the Polo Coconut Plantation

(*a*) The Craft copra drier, Zamboanga



(*b*) The Craft copra drier. The trays pulled out and charged with coconuts for drying

Everything considered, the Patalon drier is especially suited to the needs of the small planters, those with less than 200 hectares in coconuts. If a good grade of *adobe* stone is found on the plantation, this might be used for the stone work. Stones and boulders also can be used, using cement or lime mortar for a binder. If these materials are lacking, but clay suitable for the making of bricks is present, bricks may be made and used for the construction of the arch and walls.

The first drier at Patalon was built with one arch of stones and cement, boxed in with boards to retain the heat, but the woodwork caught fire and burned down. In the meantime the coconut crop had increased so that more drying space was needed and in 1921 a new drier with a larger capacity was built. The new drier (Plate X and XI and fig. 4) has a drying space of 5.4 by 12 meters, (18 by 40 feet). Two arches, a meter high on the outside from the floor, about 2 meters wide at the base, 12.5 centimeters (5 inches) thick, are set parallel with each other at each end of the grill, and serve as furnaces which are fired from both ends. Five pairs of flues of sheet iron, approximately 30 centimeters in diameter, extend horizontally from each furnace towards the center where they connect with a flue built of brick, parallel with the furnaces, through which the smoke is carried to two chimneys, one at each end of the brick flue. Facing the ends of the brick flue there are two vents in the outer wall of the chimneys through which ash accumulating in the flue can be raked out. The furnaces, and the space between, containing the flues, are enclosed with a brick wall, 1.20 cm. high. With the ends resting on the walls, stringers are laid above the furnaces and flues about a meter apart, on which are laid narrow slats—split bamboo would do—spaced so far apart as to permit the free passage of the heated air from below, without allowing the copra to fall through. Four doors, one on each side of the chimneys, admit entrance to the sheet iron flues beneath the grill, and together with the air vents at the base of the wall at the short ends of the enclosure assure circulation of air.

The drier is housed in a bodega 10.5 by 17.5 meters square, with a floor of concrete. Exclusive of the bodega, the cost of the drier and floor is ₱1,300, which could be reduced considerably by having an earthen instead of a concrete floor.

Faults of the latest model of the Patalon drier are that the copra dries unevenly, drying faster above the sheet iron flues than above the furnaces, and that the heat eats through the sheet iron where it is joined to the furnace necessitating re-

pairs every few weeks. These defects might be overcome by using brick flues altogether, and in the second instance by making flues of heavy boiler sheet iron.

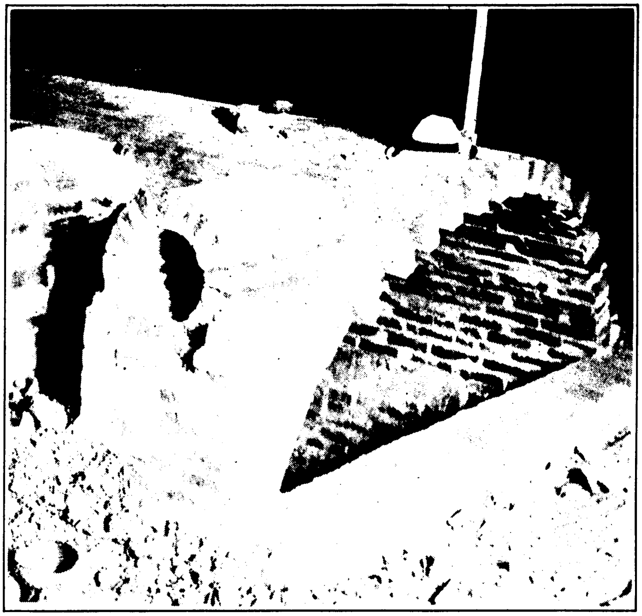
In making copra, the nuts are husked and then split with a bolo. The halves are placed with the meat facing downward on the grill—over the sheet iron flues where the heat is greatest—for a preliminary drying to loosen the meat from the shells. After the meat has been removed from the shells, it is placed above the furnaces where the heat is less intense for a final drying. The furnaces are fired with coconuts husks and shells, and the heat radiates from the furnaces and flues, and dries the coconut meat in passing through the grill.

The meat of about 200 nuts can be placed on a meter square of drying surface. Two batches of copra can be dried for each 24 hours. On the drier described, 24,000 nuts (105 piculs of copra) are dried in a week of 6 working days, the heat being maintained continously day and night. In other words, a drier of the size as heretofore described operated 50 weeks per year is capable of taking care of 200 hectares of coconuts, planted 10 meters apart, 100 trees to the hectare, averaging a yield of 60 nuts per tree per annum.

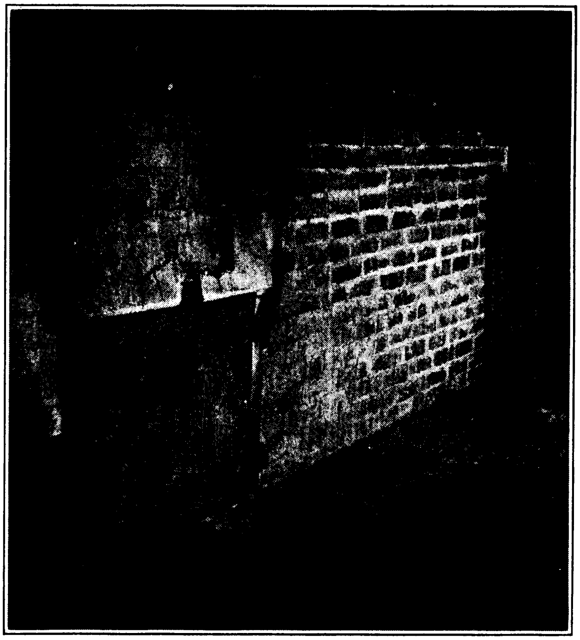
For smaller plantations a correspondingly smaller drier, the cost of which would be correspondingly reduced, naturally would suffice.

Chopping the coconut meat fine which would hasten the drying, and substituting trays on which to place the copra in place of the grill, would probably reduce somewhat the cost of the manufacture of copra on the Patalon drier.

The writer takes pleasure in acknowledging his indebtedness to Mr. H. J. Detrick for a photograph for Plate VII–*b;* to Mr. R. W. Craft for photographs for Plate IX, and to Mr. Otto Galle for photographs for Plates X–*a*, and XI–*a*, and for the courtesies shown and information given by them and Mr. Jesus Montenegro relative to their respective copra driers during his visit to their plantations.



(*a*) The Patalon copra drier. Near view of arch in course of construction



(*b*) Interior view of the Patalon copra drier with copra in process of drying. Furnace door to the left; base of chimney to the right

(*a*) The Patalon copra drier in course of construction

(*b*) Bodega housing the Patalon copra drier

SOME OBSERVATIONS ON ROOT GRUBS (*LEUCOPHOLIS IRRORATA* CHEVR.) IN THE PHILIPPINES AND SUGGESTIONS FOR THEIR CONTROL

By Faustino Q. Otanes

A very serious outbreak of root grubs occurred in many localities in the Philippines during 1923. In the Province of Batangas in particular the grubs did much damage to sugar cane and upland rice, the destruction of whole fields having been attributed to them. At about the middle of October, 1923, the writer went to Balayan, one of the infested localities in Batangas, not only to suggest remedies to the farmers but also to gather data especially such as might have a bearing on control measures. A considerable number of the grubs were also collected and taken to Manila for rearing and study at the Singalong Experiment Station. By March 3, 1924, some beetles had emerged and the species turned out to be *Leucopholis irrorata* Chevr. No other species of beetle but this has been reared from the grubs. Root grubs which were damaging canes, mango, and other seedlings in Manila were likewise collected, examined, reared to adults and they were found identical with those collected from Batangas.

There has not been any published record or account so far in the Philippines of *Leucopholis irrorata* as being an important pest of sugar cane, at least. Even in Woodworth's host index of insects injurious to Philippine crops, which has been recently published, this species is not listed. The most commonly mentioned root grub pest of sugar cane in the Philippines is that of *Holotrichia vidua* Sharp and this is listed in Woodworth's index. This latter species is said to be very destructive to sugar cane in Negros.

DISTRIBUTION, LOCAL NAMES, AND FOOD PLANTS

Leucopholis irrorata belongs to the family *Scarabaeidae*, subfamily *Melolonthinae*. In his catalogue of Philippine Coleoptera, Schultze lists four other species of the genus, but *irrorata* is undoubtedly the most common. This species, from all indications, is widely distributed in the Philippines. The beetles are very abundant in Luzon. Some specimens in the Bureau of Agriculture collection were collected from Negros and Davao.

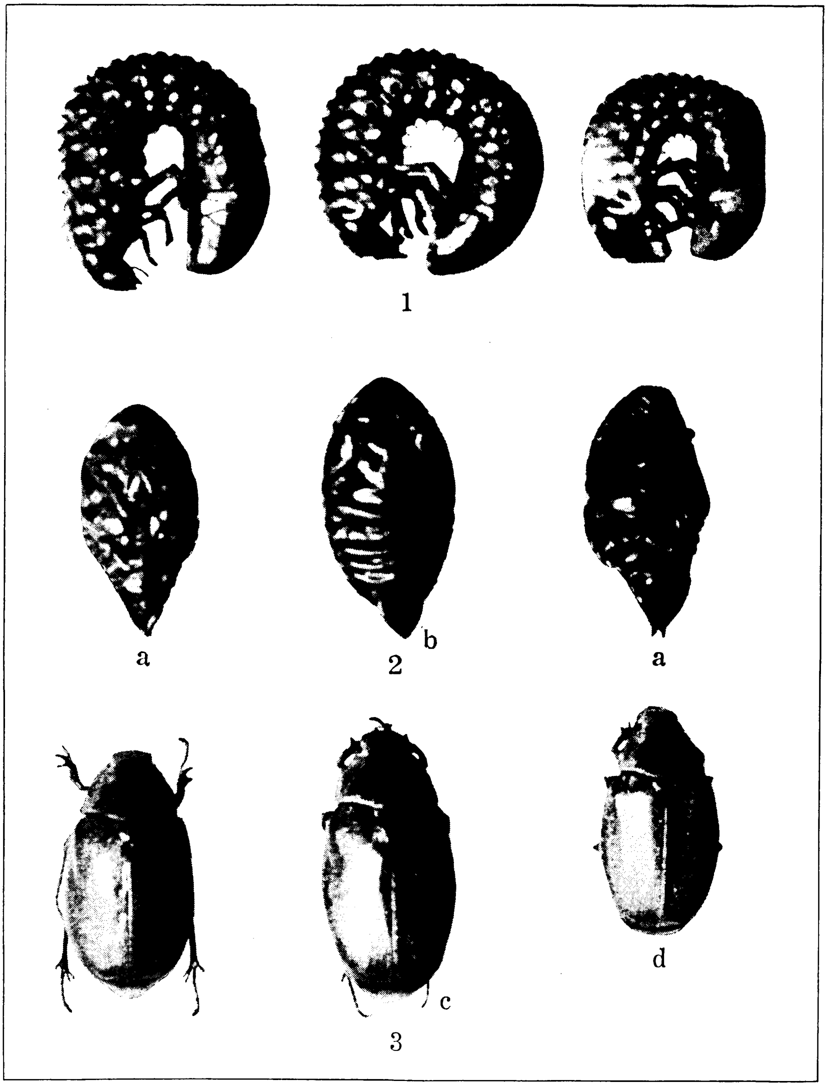
The insect has various local names. It is called "salagubang" in Tagalog, "abal-abal" or "sibbaoeng" in Ilocano, "saligubang" in Pampango, and "labog-labog" in Iloilo Visayan. The beetles are well known, as boys and girls in particular are very fond of collecting them for toys and they match them in combat.

The grubs as well as the beetles are polyphagous. The grubs have been observed feeding not on the roots of sugar cane (*Saccharum officinarum*), corn (*Zea mays*), rice (*Oryza sativa*), and Guinea grass (*Panicum maximum*) but also on those of mango (*Mangifera indica*), santol (*Sandoricum indicum*), the *Cannas*, pineapple (*Ananassa sativa*), water melon (*Citrullus vulgaris*) and peas (*Pisum sativum*).

The beetles are known to feed on the leaves of mango, acacia (*Cassia siamea*), mabolo (*Diospyros discolor*), sirihuelas (*Spondias purpurea*), santol, duhat (*Eugenia jambolana*), tamarind (*Tamarindus indicus*) and on those of uncultivated trees as anonang (*Cordia myxa*) and alodig (*Streblus asper*). A detailed study on this insect will probably increase this list of its food plants.

NATURE AND EXTENT OF INJURY

According to information from many planters in Batangas the injury by the grubs to sugar cane begins to be noticed in the latter part of September or early in October, as large portions of cane fields wilt during this period. During his visit at Balayan, Batangas, at about the middle of October, 1923, the writer noticed that in some fields 40 to 50 per cent of the canes had already wilted as a result of the injury, while in others all of the canes had already wilted. Examinations of the wilted plants showed that all of the roots had been cut with only very short portions of the roots remaining on the plants and all of these were dead. The grubs also ate off portions of the stems of the canes as shown by the presence of holes or cavities (See Plate XIII–*a*) and in some cases grubs were found in these cavities. Based on their observations in previous years, the owners of the cane fields which were only partially wilted informed the writer that all of the plants in those fields would wilt before the milling season, which usually begins in December and lasts until April. This is not at all impossible for in the same field those plants which had not yet wilted were also found grubby. Moreover, the grubs are able to move from plant to plant. Mr. Ignacio Lainez, a prominent planter in Balayan, Batangas, and at whose request the writer was detailed to go to Balayan, made the statement that 80 per cent



Photograph of *Leucopholis irrorata* showing different stages, (1) grubs or larvae, (2) pupae, (*a*) ventral aspect, (*b*) dorsal aspect, (3) adults, (*c*) female, (*d*) male

(*a*) Stems of sugar cane showing root system damaged by grubs *L. irrorata*. Note also holes or cavities on stems made by the grubs

(*b*) Mango seedlings killed by the grubs. Note the total absence of roots of some of the seedlings

of the cane sap may be lost as a result of the wilting. Some farmers who attended the Labor Conference in Manila in May, 1924, said that in many fields the cane crops are a total loss.

At Harrison Park, Manila, the grubs did considerable damage to the canes owned jointly by the Bureau of Agriculture and the Philippine Sugar Association for propagation purposes.

At the Singalong Experiment Station the grubs killed 60 to 70 per cent of the mango seedlings grown for stock. They also threatened to destroy the entire plot of pineapple seedlings at the station which were introduced from Hawaii.

Although the beetles feed on the leaves of mango and other trees, the damage done is not so serious as to be of any account. We have yet to find instances wherein the damage results in the trees being defoliated. While cases of tree defoliation by beetles are commonly observed, they are not due to *L. irrorata* but to other related beetles of the genera *Adoretus* and *Anomala.*

ABUNDANCE OF THE GRUBS

In a badly infested field at Lukban, Balayan, in October, 1923, the number of grubs taken from cane plants ranged from one to six, the average being four.

In another field at Durungao, Balayan, an area of five meters square in a portion of the field which was badly infested, that is, where the plants had already wilted, was marked off. The number of plants in that area was 42 and the number of grubs collected therefrom was 112, which meant an average of four grubs from one square meter and three grubs from each cane plant. Based on the average for each square meter there were theoretically about 40,000 grubs in one hectare of that field. As stated previously the plants which had not yet wilted were also found grubby; so this figure is probably not high.

At Pook, also a barrio of Balayan, and about one kilometer north of Durungao, the writer met a tenant who was plowing a field to be planted to cane in December, 1923, or January, 1924. The field was in cane in 1922. It was planted to corn in May, 1923, and it was plowed for the first time for cane in August, 1923. At the time of the writer's visit in October, it was being plowed for the second time and was to be plowed three more times before planted to cane in December, 1923, or January, 1924. The rather large numbers of grubs exposed by the plow attracted the writer's attention. So in order to obtain an idea as to the abundance of the grubs in that field the plow was followed eight times and the grubs from each

furrow collected and recorded. The following table shows the numbers collected:

Furrows	Number of grubs collected
1	21
2	27
3	30
4	25
5	19
6	28
7	20
8	28
Average number of grubs per furrow	24

The length of the furrows which also represents the width of the field was 114.5 meters and the length of the field, 174.3 meters. The average width of each furrow was about 15 centimeters. With these figures it was easy to calculate the number of grubs that might be present in one hectare of that field. The area of that entire field was 19,957 square meters or approximately two hectares. The number of grubs in the whole field was calculated to be 27,840 or approximately 14,000 in a hectare. The tenant informed the writer that grubs were abundant in the entire field so that the figure was by no means high. As a matter of fact, there would be more than 14,000 grubs in a hectare of that field as only those that were exposed by the plow were collected and recorded.

Meager as these data are, they give an idea as to the number of grubs that might be collected in a hectare of badly grub-infested cane or corn field. That there is a very noticeable difference between the calculated numbers of grubs in the two fields, in the one case with cane and in the other without and was previously in corn, may be due to several reasons, among which are: (1) the relative abundance of adults in the two barrios where the two fields are located during the egg-laying season of the beetles, that is, during May, June, and July, (2) the fields had entirely different crops during those months, and it is an open question whether the adults prefer to oviposit more in cane than in corn fields, (3) some of the grubs have been crushed during the plowing as was observed, and (4) dogs were observed following the plow and they gorged themselves with the grubs thus resulting in the decrease of the numbers of the latter.

Measurements of the grubs were taken. They were about 4.5 centimeters long, 1.2 centimeters broad, and 0.8 centimeter thick, and weighed on the average about 2.6 grams. Knowing

the average weight of each grub an idea may be obtained as to the weight of grub that may be collected from a hectare of grub-infested cane field at the age in which the grubs were found in October. In the case of the first field, for example, in which the number of grubs per hectare was calculated to be 40,000 there would have been collected 104 kilos of grubs from a hectare of that field and in the second field without cane but previously in corn there would have been collected 36 kilos of grubs.

DESCRIPTIONS

The egg.—At this writing (June 3, 1924) eggs laid in the soil have not been collected. However, some females were dissected and the full-grown eggs obtained were milky white, shiny, smooth, ellipsoidal and are on the average about 3.5 millimeters long and 2.5 millimeters in diameter (see Plate XIV, Fig. 1).

The grub.—The grub appears as shown in Plate XII, Fig. 1. It is fleshy, wrinkled or corrugated and is normally curved.

The full-grown grub is pale yellow, about 5.5 centimeters long, 1.4 centimeters wide, and 1 centimeter thick. The head, the legs, and the plates surrounding the spiracles are brownish yellow. The distal half of the mandibles are entirely black. The hind portion of the abdomen appears blackish due to the intestinal contents which are visible through the semitransparent skin. The entire portion of the back, from the first to the sixth abdominal segments, and including the anterior margin of the seventh, and the posterior portion of the anal segment, are covered with stout, brownish and thickly set setae. The setae on the ventral surface and along the sides of the body are longer, weak and are quite sparse. A drawing of the ventral aspect of the anal segment of the full-grown grub (Plate XIV, Fig. 2) may aid one in identifying the grub of the species.

The pupa.—The pupa (Plate XII, Fig. 2) is brownish yellow, shiny, especially the thorax, wing pads, and the legs. It is about 3 centimeters long, 1.6 centimeters wide, and 1.2 centimeters thick. The segments and the spiracles are very distinct. A large portion of the dorsal surface of the last four abdominal segments are distinctly rugose under the hand lens.

The adult beetle.—The beetle is glossy and blackish with a reddish tinge. (See Plate XII, Fig. 3.) A careful examination with a hand lens or under a binocular microscope shows that the body, the legs, and the elytra, are closely pitted and the pits bear gray scales, which vary in shape, from almost circular to oblong, the latter shape predominating. The pits and the scales are especially numerous on the ventral surface of

the body. It is these scales which give the insect a speckled and grayish appearance when looked at with the naked eye.

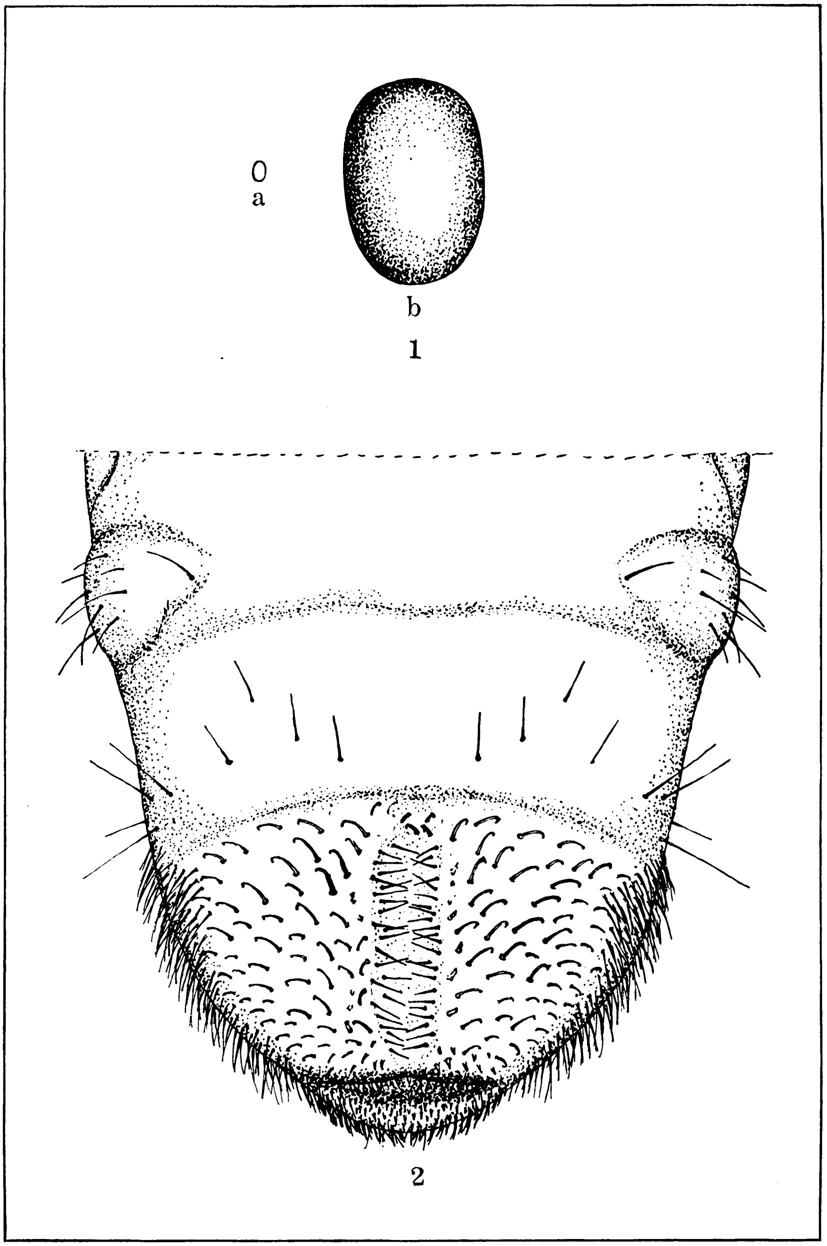
In appearance the sexes look very much alike, but the male is considerably smaller than the female. The male is on the average about 2.5 centimeters in length and 1.4 centimeters in breadth. The corresponding measurements for the female are 3 centimeters and 1.6 centimeters, respectively.

LIFE HISTORY AND HABITS

In view of the fact that the life-history of *L. irrorata* has not as yet been thoroughly studied, no definite statement can be made as to the length of the period for each of the different stages. Certain observations, however, as the uniform size of the larvae collected during the period of their destructiveness, that is usually from September and on until February and even until March as was observed by us in Manila and the absence of the grubs from April to June, at least, and only pupae and adults are collected during this period, indicate that the life cycle occupies about a year.

From records and observations taken at Manila, some pupae begin to develop into the adult stage at about the last days of March. At the Singalong Experiment Station beetles were found together with the pupal skins in the ground among the roots of mangoes and Guinea grass on April 10, 1924.

Under the writer's direction, Mr. Pedro Sison, assistant plant inspector, made rather detailed observations on the depths at which the grubs pupate in the soil. According to Mr. Sison's data the depth of the surface soil at the Singalong Experiment Station, ranges from 22 centimeters to 34 centimeters, the average being 26 centimeters. On April 25, May 6, 7, and 8, 1924, he obtained 45 measurements of the depths at which the pupal skin and adults were found in the soil. These measurements ranged from 18 centimeters to 47 centimeters, almost half a meter, and the average 30 centimeters. According to the above figures most of the grubs pupate below the surface soil, that is, in the subsoil. The adults and the pupal skin were invariably found together in the soil. During the dates on which the measurements were taken no more pupae were collected. Toward the end of May, 1924; that is from the 22d of that month, the adults were still very scarce on the wing in Manila while they were still found in large numbers in the soil among the roots of mango and other plants together with the pupal skins, which indicate that the beetles remain in the soil for sometime after they cast the pupal skins, the length of the period



1. Egg of *Leucopholis irrorata*, (*a*) natural size, (*b*) enlarged

2. Ventral view of anal segment of full-grown grub. Note the anal slit, the hooked setae and the median double row of setae, directed inward

probably depending upon the amount of rainfall. In Manila and in the immediate vicinity of the city there was hardly any rain up to May 25, 1924, which probably accounts for the fact that the beetles were still scarce on the wing before that date, when as previously stated adults were already found in the soil on April 10, 1924. On May 26, there was a light rain and this was followed by heavy rains on May 27 and May 28. On May 29, the beetles were already collected in numbers from trees at the Singalong Experiment Station and the writer even caught a few beetles around electric lights on the night of May 29. On June 2, as many as 68 beetles were collected from one mango tree about 8 meters high and with a crown of about 4 meters in diameter.

The adults are nocturnal in habit. During the day they are inactive and are commonly found clinging on the leaves and twigs of trees and they can be easily knocked off by shaking the trees of their branches. This habit of the adult is of great help in the effort to control the adults as discussed beyond.

CONTROL MEASURES

Once fields of upland rice or sugar cane or corn have wilted as a result of the injury by the grubs no effective and economical methods are known to kill the pests and thereby save the crops. While certain chemicals, as carbon bisulphide, sodium cyanide, calcium cyanamide, etc., can be used to kill the grubs in the soil, the use of these substances in rice and sugar cane fields, bearing in mind the extensive hectarage of these crops in the Philippines, is not recommendable at present, in view of the absence of comprehensive tests to show whether or not their application is economical under local conditions, especially from the standpoint of the average Filipino farmer. Even in other countries more advanced in agriculture than the Philippines, as in the United States, for example, the application of chemicals with field crops with the view to kill the grubs in the soil is very seldom, if ever practised and is not at present advocated. The cultural and mechanical methods, as crop rotation, plowing and handpicking and the use of natural enemies of the grubs, as insect predators and parasites, hogs, domestic fowls, and wild birds, are the ones that are widely employed and chiefly recommended by entomologists. There are many points to be taken into account in the application of chemicals, among which are the cost of the chemicals, the amount sufficient to kill the grubs at a certain age or stage without any appreciable injury to the plants, the most susceptible stage or

age of the grub, the most economical methods of applying the chemicals with the least expenditure of time and labor and the gain that accrues from the application. To say the least, chemicals would have a very limited application for grub control in sugar and sugar cane fields, although they may be used with advantage in saving a few plants in garden and orchards from grub injury, as will be seen subsequently in this paper.

One of the cheapest and most practicable methods that can be used at present in combating the grubs of *L. irrorata,* is collecting them by hand, the object being not only to minimize immediate injury by them but also to reduce the numbers of adults that will emerge and infest the next year's and other subsequent crops. This method is more a matter of prevention than remedial, and prevention is worth more than cure. This method is especially to be recommended in places where ratooning is very rarely, if ever practised, as in Balayan, Batangas. During the preparation of the land, as previously stated elsewhere, large numbers of grubs are exposed by the plow and it is easy to pick them up. They should be collected and fed to hogs, dogs, and poultry. Children can be employed in this work at comparatively lower wages than those for men or women. For this method to be effective, however, it should be widely practised by the farmers.

Hogs are very fond of the grubs. They should be allowed to root in the field after the sugar cane and rice have been harvested. Chickens and dogs, as was observed in Batangas, are also fond of the grubs and they, together with hogs, should be encouraged to follow the plow. Extensive observations have been made by American entomologists, notably Forbes and Davis, on the pasturing of hogs in fields with the object of controlling grubs and the system is strongly advocated by them. It may be mentioned in this connection that analyses (from Davis) made in the United States of white grubs and May beetles of the genus *Lachnosterna* (now *Phyllophaga*) show that these insects are quite rich in crude protein the percentage for the grubs being 11.1 and that for the beetles 20.1, which are higher than that for corn, which is only 10.3 per cent. Speaking of white grubs in the United States, Folsom states that together with corn, the grubs make a balanced ration for hogs and poultry. He also states that as human food, the grubs make excellent salad.

In the United States crows and crow blackbirds are known to feed on white grubs and they follow the plow, and they are even known to overturn large areas of sods in eager search for

the grubs. If our species of crows in the Philippines, as well as other birds, have these habits they should not be disturbed. In this connection, even if the writer digresses, it may be said that there is in the Philippines much indiscriminate shooting and trapping of birds and likewise stealing of birds' egg and young from their nests, in ignorance and thoughtlessness of the rôle that certain birds play in helping us mitigate the ravages of insects and other pests. Birds, well known for their insectivorous habits, like the "martinez" (*Aetheopsar cristatellus* Linn), which used to be a common sight in many places in the Philippines, have become scarce in those places, partly because they have been reduced in numbers or have been scared from those places, or both, by shooting and trapping. Boys are especially guilty in this respect. Laws against the shooting and catching and caging of birds should be strictly enforced. The necessity of preserving our bird life and our game life in general should be impressed upon the minds of the people, especially in those of boys and girls. Many species of wild life in the Philippines are threatened of extinction as a result of indiscriminate shooting and hunting. This can only be averted by strict law enforcement and widespread education, especially among the youth.

In gardens, nurseries, and orchards, the plants infested by grubs may be saved by digging around the roots and search for the pest. This pays for after the grubs have killed one plant they move on to other plants. This method was the one chiefly used in saving the pineapple seedlings, and likewise the mango and santol seedlings, at the Singalong Experiment Station from complete destruction by the grubs. Carbon bisulphide was also used, 1 to 4 cubic centimeters of this liquid being applied near the base of each mango and pineapple seedling, and was found effective in killing the grubs, without any noticeable injury to the plants by the chemical. In applying the carbon bisulphide a hole was made by means of a crowbar 15 to 20 centimeters from the base of each plant and the liquid measured and introduced into the hole by means of a graduated glass tube, after which the hole was closed with soil and the ground around the plant firmed by tramping on it so as to allow the gas to diffuse within the soil. GREAT CARE SHOULD BE TAKEN IN USING THE CARBON BISULPHIDE; IT SHOULD NOT BE USED WHEN SEEDLINGS ARE NEWLY TRANSPLANTED, THAT IS BEFORE THEY HAVE FIRMLY ROOTED AND SHOULD NOT ALSO BE APPLIED AFTER WATERING WHEN THE SOIL IS WET, WHEN THERE IS LIKELIHOOD OF HAVING A STRONG RAIN JUST AFTER APPLICATION, AS THE

204619——3

PRESENCE OF EXCESSIVE MOISTURE IN THE SOIL IS SAID TO RETARD THE CHANGING OF THE LIQUID INTO A GAS, THUS RENDERING IT LESS EFFECTIVE AND THE ROOTS OF THE SEEDLINGS LIABLE TO INJURY. CARBON BISULPHIDE IS HIGHLY INFLAMABLE AND ALL POSSIBILITIES OF FIRE SHOULD BE AVOIDED. CARE SHOULD ALSO BE TAKEN TO AVOID AS MUCH AS POSSIBLE INHALING THE GAS AS IT IS POISONOUS ESPECIALLY TO PEOPLE WITH WEAK LUNGS AND HEART.

Another method of controlling the grubs consists in the importation from other countries their natural enemies as insect predators and parasites, and propagate and liberate them in the Philippines in addition to those that may be present here already. This method has been used with success in the Hawaiian Islands for similar and other pests. According to printed and verbal information from the entomological force as well as from prominent sugar planters in the Hawaiian Islands, the cane grub (*Anomala orientalis*), which used to be very destructive in those islands was subdued by this method, by the importation from the Philippines of a certain wasp (*Scolia manilae*), which has the habit of digging into the soil, searches for the grubs, stings and paralyzes them, after which she lays her eggs on her victims, and the larvae of the wasp upon hatching begin to feed upon the bodies of the paralyzed grubs by sucking their juices. This method had given remarkable results in the United States and is being used in connection with many important agricultural pests in that country. This method is naturally slow, requires adequate funds for the salaries, traveling expenses and equipment of biologists, may involve years of pilgrimage and toil by such men in all nooks and corners in other regions of the earth, their labors may be fruitless for many years, or may be an entire failure, but it pays to try, for once effective parasites and predators are found and established in the country the fight is won for the farmers. The method pays in the long run. The experience of other countries proves it so.

CONTROL OF THE BEETLES

The adult beetles can best be controlled by collecting them, as is done in Europe, the object being to reduce their numbers and thus their infestation. Observations should be made in each locality as to when the beetles first appear on the wing and the collection should begin promptly from that time on so as to prevent as much as possible the laying of eggs. In order to obtain the desired result by this method like the collection of the grubs, community coöperation is essential, particularly

among the farmers. In this respect the problem is not different from other civic problems. In the case of cholera, for example, individual attempts to stop the epidemic are futile without community coöperation. In the same way efforts on the part of a few farmers to collect the beetles will give little or no results; the collection of the beetles has to be made a community affair.

Where community coöperation is not practicable another way of obtaining the desired result, namely the reduction of the beetles, is by means of paid collectors or by the offering of bounties to people for what they catch. The money for this purpose may be raised by contributions from farmers and the rates of payments to be fixed by the municipal officials or by the leading planters, and the campaign to be carried on under the auspices of existing agricultural organizations, if any. In Balayan, for instance, this can be undertaken under the initiative and encouragement of the "Sociedad de Agricultores," which comprises nearly all of the leading cane planters in that municipality.

Birds and other animals that feed on the beetles should be encouraged and protected.

As has been said boys are fond of collecting the beetles. They should be encouraged to do so and familiarized with the fact that the grubs are serious enemies of sugar cane, rice, and other crops. They should be advised to feed them to chickens.

LITERATURE CITED

1. DAVIS, J. J. Common White Grubs. Farmers' Bulletin No. 940, U. S. Department of Agriculture, 1918.

2. FOLSOM, J. W. Entomology with Reference to its Biological and Economic Aspects. 1922.

3. FORBES, S. A. On the Life History, Habits, and Economic Relations of White Grubs and May-beetles. Bulletin No. 116, Illinois Agricultural Experiment Station, 1907.

4. SCHULTZE, W. A Catalogue of Philippine Coleoptera, Bureau of Science, Manila, 1915.

5. WOODWORTH, H. E. A Host Index of Insects Injurious to Philippine Crops. The Philippine Agriculturist, Vol. 10, No. 1. 1921.

IBID. A Host Index of Insects Injurious to Philippine Crops: II. The Philippine Agriculturist, Vol. 10, No. 7. 1922.

IBID. A Host Index of Insects Injurious to Philippine Crops: III. The Philippine Agriculturist, Vol. 11, No. 2. 1922.

THE STORAGE AND CURING OF BATANGAS MANDARIN ORANGES

By JOSE DE LEON, *Superintendent, Tanawan Citrus Station*

In 1920, a series of experiments on the storage and curing of the Batangas mandarin orange were conducted at the Tanauan Citrus Station. The objects of these experiments were to find a means of storing the fruits so as to lengthen the period of time in which they may be marketed, and also to improve their color and quality. It was deemed important, moreover, that such a means should be convenient and economical enough so that the growers in the citrus district may adopt them.

It was determined then that it was possible to store the fruits in an underground storage chamber for a period of time longer than it was usually thought to be possible. These preliminary investigations showed that the fruits could be made to assume a uniform orange color. In addition their general quality was considerably improved. The curing of the oranges was entirely accomplished in fourteen to twenty days after placing them in the vault. These experiments, however, showed that twenty days only was the period of time which was economically possible for the fruits to last in the chamber. After that period the loss was so great that storing would not be economically feasible with the methods employed.

Data were also obtained in these first experiments which showed that there was a larger loss in clipped fruits than in those picked by the ordinary way; that a slightly larger loss was found in the green than in the ripe fruits; and that the size of the fruits did not make any difference in its quality to last.

All these results were obtained with fruits that were not treated with any disinfecting solutions, but stored in an unventilated, underground storage chamber. This type of chamber was described in the account of the experiments, published in the Philippine Agricultural Review, Vol. 13, pp. 214–217, 1920.

The results of the second set of experiments are reported in this paper.

MATERIALS AND METHODS

The storage was conducted in an underground chamber having very similar construction as the one previously used, except that it was provided with a chimney, one foot in diameter, so that a slow current of air enters into chamber. A tight door was also provided to exclude the entrance of warm drafts during the day time. During the night this door was kept open.

The fruits used in the experiments were all harvested during the month of January, and were of about the same stage of maturity. Two methods were used in picking the fruits, one was by means of a clipper so as to leave a short portion of the stem on the fruit, and the other was by the ordinary Batangas method, i. e., by pulling and twisting the fruit, leaving no portion of the stem on the fruit.

The fruits were separated into lots and were treated as follows: (1) checked, not disinfected; (2) immersed in 0.2 per cent solution of formalin, some lots, for 3 minutes, and others for 5 minutes; (3) immersed in 0.018 per cent solution of copper sulphate, some lots for 3 minutes and others for 5 minutes; (4) immersed for 5 minutes in potassium permanganate solution of 0.018 per cent, 0.025 per cent, and 0.05 per cent concentrations. Each lot of fruits was placed in storage two days after picking, and the different lots were similarly exposed to open air, previous to storing them in the chamber.

Table I gives a general summary of the results obtained from these experiments. Of the 1,587 fruits used, the checked lots had 419 fruits; the lots disinfected with formalin, 419 fruits; the lots disinfected with copper sulphate solution 419; and the lots disinfected with potassium permanganate solution, 330 fruits.

These results indicate that there was distinctly less decay of fruit in the lots treated with permanganate solution than in the others. After six weeks of storage, the average loss of fruit in the lots disinfected with potassium permanganate was 25.8 per cent; in those of the checked lot, 32.7 per cent; in the formalin-disinfected lots, 79.5 per cent; the checked lots, 80.0 per cent; and the copper-sulphate-disinfected lots, 82.3 per cent. The marked superiority shown by the potassium permanganate over the other disinfectants cannot be accounted for, except for its probable effectiveness in killing the organisms causing most of the decay, or, the weakness of the concentrations of the formalin and copper sulphate solutions used.

In the course of the experiments frequent examinations of the sound fruits were made. No injurious effects that may

be ascribed to the use of disinfectants were noticed. However, it became very evident that there was a lack of uniformity in the quality and behavior of the fruits. After several weeks of storage, sound fruits under the same conditions and treatments have exhibited varying qualities,—some having improved greatly in flavor and eating quality, while others not; some have remained juicy, while others became dry; and some became silky and pliable, while others remained firm and rather brittle. It should be remarked that the fruits used in the experiments were obtained from seedling trees, and it is probable that this lack of uniformity was due to the variability inherent in the fruits of such trees.

Table II presents a comparison of the extent of decay in fruits picked in the ordinary way and in those harvested with a clipper. The figures show that at the ends of the sixth and eleventh weeks, the average percentages of loss were 26.4 and 74.2, respectively, in the picked fruits, and 45.2 and 88.8, respectively, in the clipped fruits. These results agree with those already obtained in the previous experiments.

A possible explanation for this fact is as follows: An examination of the decayed fruits has revealed that about 81 per cent of the loss was due to a decay which proceeded from the stem ends of the fruits. The organism causing this decay is probably located in the stem end region of the fruit, and that it may be already present in a dormant state at the time of picking. When the stem is entirely removed from the fruit, as in the case when it is plucked off, the tissues in which the organism is lodged become hardened on exposure to the air, thus retarding or preventing entirely the development of the organism. The tendency of this organism is to develop as the fruit becomes weaker, and it is probable that this tendency is greater in clipped fruits for having a portion of the stems attached thereto, than in fruits with the stems entirely removed. However, further study is necessary before final statements can be made on this point.

SUMMARY

The results obtained, thus far, in this work may be summarized as follows:

(1) That the ventilated type of underground storage chamber has given much better results than the unventilated type, in the storage and curing of mandarin oranges.

(2) That, under the conditions in which they were grown, fruits picked in the ordinary Batangas method kept better than clipped fruits.

(3) That disinfection of the fruits by immersing it for 5 minutes in 0.018 per cent solution of potassium permanganate before placing it in the storage, has markedly improved its storing quality.

(4) That it is practicable to store mandarin oranges at least six weeks by using the ventilated type of storage chamber, and improve their appearance and eating quality. However, it is believed that this period of time is not the limit of successful storage because many of the fruits remained in good condition even after the eleventh week of storage.

TABLE I.—*Showing the percentage of decay in fruits of the Batangas mandarin orange treated with varios disinfectants, and cured and stored in an underground, ventilated chamber*

Treatment of fruits	Kind of fruits	Date placed in storage	Number	Fruits decayed—									
				1st week		2nd week		3rd week		4th week		5th week	
				No.	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*
Check:													
No treatment	Clipped, stem on	January 6, 1923	66	0	0	0	0	2	3.0	7	10.6	28	42.4
Do	do	January 13, 1923	80	1	1.3	1	1.3	5	6.3	11	13.8	15	18.8
Do	Picked, no stem	do	123	2	1.6	4	3.3	4	3.3	16	13.0	20	16.3
Do	do	January 20, 1923	150	0	0	9	6.0	21	14.0	27	18.0	29	19.3
Totals			419	3	0.7	14	3.3	32	7.6	61	14.6	92	22.0
Formalin solution—													
0.2 per cent, 3 minutes	Clipped, stem on	January 6, 1923	66	0	0	1	1.5	7	10.6	13	19.7	26	39.4
Do	do	January 13, 1923	80	0	0	1	1.3	2	2.5	4	5.0	11	13.8
Do	Picked, no stem	do	123	0	0	0	0	2	1.6	7	5.7	14	11.4
0.2 per cent, 5 minutes	do	January 20, 1923	150	0	0	4	2.7	14	9.3	22	14.7	30	20.0
Totals			419	0	0	6	1.4	27	6.4	46	11.0	81	19.4
Copper sulphate solution—													
0.018 per cent, 3 minutes	Clipped, stem on	January 6, 1923	66	1	1.5	1	1.5	7	10.6	15	22.7	37	56 1
Do	do	January 13, 1923	80	3	3.8	5	6.3	7	8.8	10	12.5	14	17.5
Do	Picked, no stem	do	123	0	0	0	0	1	0.8	5	4.1	13	10.6
0.018 per cent, 5 minutes	do	January 20, 1923	150	1	0.7	9	6.0	21	14.0	30	20.0	37	24.7
Totals			419	5	1.2	15	3.6	36	8 6	60	14.3	101	24 1
Potassium permanganate solution—													
0.025 per cent, 5 minutes	Clipped, stem on	January 13, 1923	90	0	0	0	0	0	0	3	3.3	15	16.7
.05 per cent, 5 minutes	do	do	90	0	0	1	1.1	4	4.4	8	8.9	14	15.6
.018 per cent, 5 minutes	Picked, no stem	January 20, 1923	150	1	0.7	5	3.3	12	8.0	23	15.3	29	19.3
Totals			330	1	0.3	6	1.8	16	4.8	34	10.3	58	17.6

Treatment of fruit	Kind of fruit	Date placed in storage	Number	Fruit decayed 6th week		Fruit decayed 7th week		Fruit decayed 8th week		Fruit decayed 9th week		Fruit decayed 10th week		Fruit decayed 11th week	
				No.	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*
Check:															
No treatment	Clipped, stem on	January 6, 1923	66	44	66.7	48	72.7	54	81.8	59	89.4	62	93.9	63	95.5
Do	do	January 13, 1923	80	25	31.3	37	46.8	47	58.8	52	65.0	57	71.3	65	81.5
Do	Picked, no stem	do	123	29	23.6	39	31.7	53	43.1	68	55.3	86	69.9	93	75.6
Do	do	January 20, 1923	150	39	26.0	53	35.3	76	50.7	88	58.7	99	66.0	114	76.0
Totals			419	137	32.7	177	42.2	230	54.9	267	63.7	304	72.6	335	80.0
Formalin solution—															
0.2 per cent, 3 minutes	Clipped, stem on	January 6, 1923	66	37	56.1	53	80.3	58	87.9	62	93.9	65	98.5	66	100.0
Do	do	January 13, 1923	80	24	30.0	40	50 0	48	60.0	56	70.0	60	75.0	63	78.8
Do	Picked, no stem	do	123	27	22.0	55	44.7	81	65.9	97	78.9	110	89.4	111	90.2
0.2 per cent, 5 minutes	do	January 20, 1923	150	51	34.0	61	40.7	71	47.3	82	54.7	87	58.0	93	62.0
Totals			419	139	33.1	209	49.9	258	61.6	297	70.9	322	76.9	333	79.5
Copper sulphate solution—															
0.018 per cent, 3 minutes	Clipped, stem on	January 6, 1923	66	48	72.7	53	80.3	61	92.4	63	95.5	63	95.5	63	95.5
Do	do	January 13, 1923	80	20	25.0	35	43.6	47	58.8	57	71.3	63	78.8	69	86.3
Do	Picked, no stem	do	123	29	23.6	54	43.9	73	59.4	82	66.7	105	85.4	113	91.9
0.018 per cent, 5 minutes	do	January 20, 1923	150	48	32.0	61	40.7	73	48.7	80	53.3	95	63.3	100	66.7
Totals			419	146	34.8	203	48.5	254	60.6	282	67.3	326	77.8	345	82.3
Potassium permanganate solution—															
0.025 per cent, 5 minures	Clipped, stem on	January 13, 1923	90	30	33.3	43	47.8	58	64.4	64	71.1	77	85.6	80	88.9
.05 per cent, 5 minutes	do	do	90	22	24.4	26	28.9	39	43.3	49	54.4	66	73.3	69	76.7
.018 per cent, 5 minutes	Picked, no stem	January 20, 1924	150	33	22.0	47	31.3	65	43.3	79	52 7	89	59.3	95	63.3
Totals			330	85	25.8	116	35.2	162	49.1	192	58.2	232	70.3	244	73.9

TABLE II.—*Extent of decay in Batangas mandarin oranges picked by the ordinary way and by clipping*

Clipped	Total number	Fruits decayed			
		Sixth week		Eleventh week	
		Number	Per cent	Number	Per cent
Not disinfected	80	25	31.3	65	81.3
Disinfected with formalin	80	24	30.0	63	78.8
Disinfected with copper sulphate	80	20	25.0	69	86.3
Not disinfected	66	44	66.7	63	95.5
Disinfected with formalin	66	37	56.1	66	100.0
Disinfected with copper sulphate	66	48	72.7	63	95.5
Averages	438	198	45.2	389	88.8
PICKED ORDINARY WAY					
Not disinfected	123	29	23.6	93	75.6
Disinfected with formalin	123	27	22.0	111	90.2
Disinfected with copper sulphate	123	29	23.6	113	91.9
Not disinfected	150	39	26.0	114	76.0
Disinfected with formalin	150	51	34.0	93	62.0
Disinfected with copper sulphate	150	48	32.0	100	66.0
Disinfected with Potassium permanganate	150	33	22.0	95	63.3
Averages	969	256	26.4	719	74.2

THE USE OF FUNGICIDES IN THE PHILIPPINES

By GAUDENCIO M. REYES and F. B. SERRANO

The use of fungicides has not been extensive in this country as yet. However, the steady increase in agricultural knowledge will eventually bring up the question of fungicides in the prevention of plant diseases. It is therefore desirable to know at the start what materials are available for use and their various advantages and disadvantages.

The most commonly practiced uses of fungicides are in (1) treatment of seed by dipping, (2) treatment of nursery trees by dipping, (3) occasional practices of painting trees with fungicides, and (4) the spraying of orchard or field crops.

Each one of these methods is a subject which may be treated upon rather extensively but for the present discussion, it is advisable to confine the subject to spraying of orchard and field crops.

There are two general classes of fungicides which have had the most common and successful use in the past; those solutions and mixtures which depend for their fungicidal value on the toxic effects of copper and those which owe their toxic effects to sulphur and its compounds.

COPPER GROUPS

Of the copper fungicides there are a number but those in the most common use have been Bordeaux mixtures of various concentration, Burgundy mixtures, ammoniacal copper carbonate, and copper sulphate as a solution. Each of these mixtures has its advantages and disadvantages and different situations and conditions may make one or the other the most suited. The preparation of a few of these mixtures is briefly described here.

For the preparation of copper sprays it is advisable to have the following outfit on hand at the beginning of operations:

1 wooden barrel holding 200 or more liters (50 gallons).
2 wooden buckets of from twelve to twenty liters capacity.
Rough balances for weighing materials.
A wooden paddle for mixing the different constituents.

All containers such as barrels, pails, etc., should be of wood or earthenware, since copper reacts with steel or iron containers, spoiling both the spray mixture and containers.

BORDEAUX MIXTURE

To make two hundred liters of Bordeaux mixture, purchase 1.8 kilos of copper sulphate (bluestone) ; this will come as dark blue crystals. Also 1.8 kilos unslaked lime (calcium oxide, not hydroxide) ; this will come in hard white lumps. A white powder is usually the hydroxide and should not be accepted. Both of these ingredients should be of commercial purity only, it is of course entirely unnecessary to use chemically pure substances for these preparations. The copper sulphate should be placed in a loose cloth bag ("sinamay" would be an excellent material) and suspended in ten liters of water in one of the wooden pails. The purpose of suspending the sulphate crystals in bag is to quicken the solution of the copper sulphate in the water. When the lumps of copper sulphate have all been dissolved, this solution should be poured into the large wooden barrel and water added to make one hundred fifty liters.

Next the 1.8 kilos of lump lime should be placed in one of the wooden pails and just enough water added to wet the lime. The lump lime will begin to steam and crumble which will last about five or ten minutes after which more water should be slowly added to fill the pail. This should then be stirred steadily with a paddle and then slowly poured into the copper sulphate solution; this pouring of the lime should be very slow and with vigorous and continuous stirring.

The lime should be diluted with water as much as the pail will allow for the proper precipitation of the copper does not take place if carried on two rapidly or at too great a concentration. The resulting mixture will be a deep blue color. Water should then be added with continued stirring to make the 200 liters. This mixture has a better covering and adhering capacity if applied immediately after preparation; it deteriorates rapidly and should be applied immediately, or at least, on the same day that it is prepared.

For emphasis it is well to recapitulate some of the important points.

Slaked lime (calcium hydroxide) should not be used; hard, lumpy unslaked lime should be obtained. It is at its best when kept in air-tight cans.

Only wooden or earthenware buckets or barrels should be used. The copper sulphate and the lime should not be mixed in concentrated solution.

The mixture should not be allowed to stand after preparation, it should be used promptly after it is made.

BURGANDY MIXTURE

Burgundy mixture is considered as a substitute for Bordeaux and it is used where fresh quicklime or unslaked lime cannot be obtained. It is claimed to be more convenient to prepare than Bordeaux mixture and if prepared correctly, does not produce sediment, which gives trouble to the spray nozzles.

This mixture is prepared by disssolving 1.64 kilos of bluestone (copper sulphate) in 15 liters of water; in this case also the copper sulphate crystals may be made to dissolve more rapidly by placing them in a loose cloth suspended in the water. This solution should be prepared in an earthenware or wooden container and then diluted with water to 150 liters. Next weigh 1.64 kilos of salsoda (sodium carbonate) and dissolve in 15 liters of water in another wooden bucket. When solution of both materials is complete the sodium carbonate should be poured slowly into the more dilute copper solution, with constant stirring. Water should then be added to make 200 liters of the mixture, stirring constantly while adding.

In our experience, a little excess of salsoda did not cause any injury to the sprayed plants.

AMMONIACAL SOLUTION OF COPPER CARBONATE

This solution is made by dissolving copper carbonate in ammonia-water in the following proportions:

Copper carbonate	140 grams.
Strong ammonia	1.5 liters.
Water	200 liters.

If properly made it contains no sediment and is therefore good for spraying ornamental plants, marketable fruits, and other delicate plants in cases where Bordeaux mixture would show and spoil the appearance of the foliage or fruits.

In preparing this mixture, first make the necessary amount of copper carbonate into a thin paste by adding about one liter of water. Then, with constant stirring add the ammonia slowly. The resulting solution should be clear, deep blue in color. Before it is ready for use it must be diluted with water to make 200 liters.

COPPER SULPHATE SOLUTION

Copper sulphate solution is prepared by dissolving copper sulphate in water as in Bordeaux mixture, in the proportion of one pound copper sulphate to 68 liters of water. Generally

it is used as a wash for dormant trees and also for disinfecting seeds of grain to free them from contamination with fungus spores and other pathogenic organisms.

Extensive control experiments on citrus diseases in the Philippines and in Japan by Lee and others have shown that scale insects and some superficially-growing fungi were greatly increased in tropical countries following the application of copper sprays. This increase in scale insects following copper sprays is much more serious in the dry season than in the rainy season. For this reason we advise very strongly that copper sprays be used in the Philippines only in the months of the wet season, even though oil emulsions are applied at the same time. Sulphur sprays are strongly advocated during the dry season. It was found feasible and effective in the months of the rainy season to control scale insects by spraying the trees with an oil emulsion in conjunction with the copper fungicide application.

Oil emulsions to use with copper sprays.—The two kinds of oil emulsions recommended for checking the scale insects are: An oil emulsion consisting of 1.8 kilos soft soap; 4 liters of paraffin oil (25° Baume hydrometer); and 4 liters of water. For use, this stock emulsion is to be deluted in the ratio of 1 liter to 50 liters of water. The other oil emulsion preparation mentioned is made by mixing one liter of cresylic soap liquor (*Liquor cresolis compositus*), 3 liters of kerosene, and water, to make 200 liters; this emulsion is easier to prepare but is considerably more expensive.

Lime sulphur has a special quality in that it does not require a subsequent spray with an oil emulsion as the copper sprays for the checking of scale insects. In other words, it serves both as a fungicide and as an insecticide. It has, however, quite a decided disadvantage as a spray for being more easily washed from the leaves than Bordeaux when used in places where heavy rains prevail.

SULPHUR GROUP

Of the suphur fungicides there are three forms which are in common use; the concentrated lime-sulphur, the self-boiled lime-sulphur, and the sulphur-dust. Each of these, preparations has its advantages and disadvantages and one may be most convenient and give the best results under one set of conditions while the others may be more advantageous under other sets of conditions. However, of these three, the first is more

commonly in use. Their preparations are briefly discussed as follows:

CONCENTRATED LIME-SULPHUR

In preparing this solution the following outfit and materials should be on hand before the operation is begun: a kettle of 50 liters or more capacity (preferably of iron or earthenware), a rough balance, a wooden paddel fresh unslaked lime, sulphur, and water. This solution is prepared in various concentrations but the formula 50–100–50 is generally taken as the standard. This means that the ingredients should be 50 pounds of unslaked lime, 100 pounds of sulphur, and 50 gallons of water. Place the lime in the kettle and add sufficient water to slake the lime; add the sulphur and with constant stirring, bring it to a boil. Continue stirring until the lime is well slaked and the sulphur thoroughly mixed in. Then make up the 50 gallons of water. Boil the mixture for from 50 minutes to one hour stirring from time to time. Add any quantity of water lost by boiling. The resulting solution which is generally called "stock solution" should have an orange-red color. To obtain the correct dilution, a hydrometer marked with degrees Baumé for liquids heavier than water should be dipped in the stock solution. Strain and keep in air-tight container. Smaller proportions may be prepared according to the quantity desired.

This stock solution must be diluted before it is ready for use. The strength suitable for use varies with the kind of plants to be treated. But under ordinary weather conditions and to most plants a stock solution with a concentration of 33° Baumé is safe to use when 1 part of it is diluted with 40 parts of water.

SELF-BOILED LIME-SULPHUR

The self-boiled lime-sulphur is a mixture of lime and sulphur boiled with only the heat of the slaking lime. This is not always as effective a fungicide as is the Bordeaux mixture, but it is commonly used for spraying the foliage of plants which sustain some injury by using either Bordeaux mixture or the concentrated lime-sulphur. It is quite adhessive and is not easily washed by rain.

Generally it is prepared in the following proportions:

Unslaked lime	8 pounds
Sulphur	8 pounds
Water	50 gallons

It is best prepared in rather large quantities, for enough heat to produce violent boiling in a few minutes is obtained by using fresh quicklime in larger amounts.

Place the lime in a barrel and pour on enough water to start it slaking. Then add the sulphur and keep the mixture stirred up from time to time. After the violent boiling is over add more water to make the necessary concentration, and strain off the sediment. The solution is then ready for use. This mixture should be stirred while being sprayed. Some kinds of spraying apparatus have self-agitators. The sprayer should have no copper parts that can be reached by the spray.

SULPHUR-DUST

This preparation consists of a very finely powdered sulphur known as "flowers of sulphur." It is especially good for fungi growing superficially on the foliage or garden and orchard plants. It is applied by means of a dusting outfit; hand duster or powder duster.

The efficacy of finely divided sulphur has been found to be greatest if used on a clear sunny day, for the heat of the sun evaporizes it and thus it becomes active. Rain will readily wash off this fungicide.

STICKER: RESIN-SALSODA

During seasons of extreme rainy days it is advisable to use a sticker to cause copper and lime sulphur fungicides to cause copper and lime sulphur fungicides to adhere to the leaves at a longer period of time possible; copper sprays and lime sulphur solutions are quite easily washed off from the foliage by a few successive heavy rainfalls.

A convenient formula for making this sticker is by mixing 2 pounds of finely powdered resin; one pound of sodium carbonate (salsoda); and one gallon of water. Dissolve the resin in a hot solution of the sodium carbonate in exactly one gallon of water. Boil gradually until the resin is thoroughly mixed in. This preparation may be used by mixing 2 liters to 200 liters of the spray.

This information we believe is sufficiently explicit for the usual orchardist or grower, however, one wishing more detailed information should consult some of the following papers:

1. BOUCART, E. Insecticides, Fungicides and Weedkillers. Translated from the French by Donald Grant. 431 pp. D. Van Nostrand Co., New York, 1913.
2. BUTLER, E. J. Fungi and Disease in Plants. 547 pp. Thacker, Spink & Co., Calcutta, 1918.

3. HOLLAND, E. B., *et al* Insecticides and Fungicides for Farm and Orchard Crops in Massachussetts. Mass. Agric. Exp. Sta. Bull. 201; 1–16, 1921.
4. LEE, H. A. Citrus–Canker Control: A Progress Report of Experiments. Philip. Journ. Sci. **19**: 129–173, *Pls. 1–2* 1921.
5. LEE, H. A. et SHINO, ARIKUNI. Citrus–Canker Control Experiments in Japan. Philip. Journ. Sci. **20**: 121–151. *Pls. 1–4, g. 1.* 1922.
6. STEVENS, F. L. Diseases of Economic Plants. 507 pp. The Macmillan Co., New York, 1922.

For convenience, the measures used and their approximate equivalents are here given:

1 pound = 453.59 grams = 16 ounces.
1 kilo = 2.2 pounds.
1 liter = 1000 cubic centimeters.
1 pint (liquid) = 0.473 liter.
1 quart (liquid) = 0.946 liter.
1 gallon = 3.785 liters = 4 quarts.

204619——4

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF AGRICULTURE
MANILA

[Circular No. 144]

THE USE OF FERTILIZERS AND GREEN MANURING ON THE FARM

By ANIANO ELAYDA, *Agricultural Assistant*

Commercial fertilizers may be regarded as artificial stimulants in crop production, like grain in the production of beef and pork, and are usually mixtures of potash, phosphoric acid, and nitrogen. The so-called complete fertilizer may be bought ready mixed or the ingredients may be bought and then mixed at home.

Plants will be small and give little or no fruit, or they will be large and give a heavy yield of fruit, according to whether or not they are the product of judicious selection and breeding and receive the required amount of food, water, air, sunlight, and attention. If the soil is poor, it is necessary to supply plant food of the proper kinds and in the proportion required by the plant. Some soils possess all the elements of plant food in sufficient quantities to develop the plant to its highest limit.

Soils will be rich in phosphoric acid, potash or lime, according to the composition of the rock from which they were formed. For example, if the soil is formed from limestone rock there will be an abundance of lime in the soil; if formed from rocks free from lime, of course there will be no lime, and the soil will likely to be sour or acid. A soil formed from a rock rich in potash will naturally be rich in this element. Most clay soils are usually rich in potash, whereas sandy soils are usually deficient in potash. The nitrogen that is in the soil comes originally from the atmosphere.

Green manuring.—Nitrogen acts in the soil in several ways. Leguminous plants, such as beans, peas, mongo, cowpeas, and soy beans, have the power of collecting free nitrogen from the air by means of certain bacteria which live in the tubercles or nodules on their roots. This nitrogen is used by these plants

in building up tissues, but when they are plowed under the nitrogen, collected by the agency of the bacteria and stored in the stems, roots, and leaves of the plants, becomes available to other plants. Soils containing large quantities of organic matter are usually rich in nitrogen. However, plants cannot make use of this nitrogen locked in the organic matter until it has decayed. As decay is hastened by exposing the soil in the air, frequent plowing will make the element available more rapidly than if the soil were allowed to lie undisturbed. When the decayed leaves and stems become incorporated in the soil, they form humus, a term applied to any partially decomposed organic matter. A soil rich in humus is generally considered a good soil.

To provide green manure a system of crop rotation should be followed to suit the locality and particular crop grown. The soil should not be continuously cropped with the same kind unless it is a very rich soil. But even in a rich soil when it shows signs of decline in fertility the major crop should be followed by leguminous crop. In this way there is partly or wholly replaced to the soil such nitrogenous plant food as has been removed by the previous crop.

It has been found that a crop of velvet beans weighing 9,605 kilos per hectare if plowed under and mixed thoroughly with the soil will leave to the soil 64.2 kilos of nitrogen which is enough nitrogen to last any ordinary crop three years. The nitrogen contained in these vines, leaves, and stem is not readily available to the growing crop, but as the vegetable matter rots, the nitrogen gradually becomes available. Even in this climate where decomposition goes on rapidly, the effect would extend at least two growing seasons.

Home mixing.—The farmer may purchase the raw materials and make his own mixtures, or he may purchase them already mixed in the proportion required by the crop. The mixing of a fertilizer is not a difficult matter if all of the materials are fresh, but under Island conditions it frequently happens that acid phosphate, muriate of potash, and nitrate of soda will take up moisture from the air and when they dry again hard lumps are formed, which must be broken up or ground to make a perfect mixture. The ingredients may be weighed out according to be formula, spread in layers on clean hard ground or on a floor and mixed two to three times until the mixture is of a uniform color. It should then be put in sacks and stored until ready for use.

In making up fertilizer formulas the percentages of the different elements required must be determined first and then the materials to be used. This can be done only by trying out different fertilizers of varying formulas for a given soil and the crop. It is not necessary to be exact down to a fraction of one per cent as fertilizer application is not an exact science, and a slight variation in the calculation will not cause any loss of agricultural value.

A ton-mixture of fertilizer, for example, is to be made to contain 2 per cent nitrogen, 8 per cent phosphoric acid, 2 per cent potash, and a certain amount of dead material known as filler to be used to make up the weight. In mixing these fertilizers, kainit containing 12 per cent potash, bone meal containing 14 per cent phosphoric acid, and cotton seed meal analyzing 7 per cent nitrogen, 2 per cent available phosphoric acid, and 1.5 per cent potash can be used. The amounts of the various materials required are as follows:

I. (*a*) In one-ton mixture of fertilizer containing 2 per cent nitrogen, the amount of nitrogen required can be determined as follows:

Since the mixture requires 2 per cent nitrogen, then 100 kilos of the material will contain 2 kilos nitrogen.

Therefore, 100:2::1,000:X

$\frac{2\times 1{,}000}{100X}=\frac{2{,}000}{100X}$ or X equals 20 kilos, the amount of nitrogen required in the mixture.

(*b*) Since cotton seed meal containing 7 per cent nitrogen is to be used in the mixture to supply the 20 kilos of nitrogen, the amount of cotton seed meal required in a one-ton mixture of fertilizer can be determined as follows:

Since cotton seed meal contains 7 per cent nitrogen, then 100 kilos of the material will contain 7 kilos of nitrogen.

Therefore, 7:100::20:X or $\frac{100\times 20}{7X}=\frac{2{,}000}{7X}$ or X equals 285.7 kilos, the amount of cotton seed meal to supply 20 kilos of nitrogen, in a one-ton mixture.

II. (*a*) In a one-ton mixture of fertilizer containing 8 per cent phosphoric acid, the amount of phosphoric acid required can be determined as follows:

Since the mixture requires 8 per cent phosphoric acid, then 100 kilos of the material will contain 8 kilos of phosphoric acid.

Therefore, 100:8::1,000:X or $\frac{8\times 1{,}000}{100X}=\frac{8{,}000}{100X}$ or X=80 kilos, the amount of phosphoric acid required in the mixture.

(*b*) Since 285.7 kilos of cotton seed meal used contain 2 per cent phosphoric acid which is equivalent to 5.7 kilos, but that only 80 kilos of phosphoric acid is required in a one-ton mixture; therefore, the amount of 5.7 kilos must be deducted from 80 kilos in order not to exceed the amount required, as follows:

285.7	kilos, cotton seed meal
×.02	or (2%), per cent of phosphoric acid in cotton seed meal
5.7	kilos, phosphoric acid
80.0	kilos, phosphoric acid required in a one-ton mixture
−5.7	kilos phosphoric acid
74.3	kilos phosphoric acid, the exact amount required.

(*c*) Since the fertilizer that will supply the 74.3 kilos of bone meal contains 14 per cent of phosphoric acid, then 100 kilos of the material will contain 14 kilos phosphoric acid; therefore, the amount of the fertilizer required can be determined as follows:

$14:100::74.3:X$ or $\frac{100 \times 74.3}{14X}$ or $\frac{7{,}430}{14X}$ or X equals 530.7 kilos, bone meal.

III. (*a*) In one-ton mixture of fertilizer containing 2 per cent potash, the amount of potash can be determined as follows:

Since the mixture requires 2% postash, then 100 kilos of material will contain 2 kilos of potash.

Therefore, $100:2::1{,}000:X$ or $\frac{2 \times 1{,}000}{100X}$ or $X = 20$ kilos the amount of potash required in the mixture.

(*b*) Since 285.7 kilos of cotton seed meal contain 1.5 per cent potash which is equivalent to 4.28 kilos, but that only 20 kilos of potash is requied in one-ton mixture; therefore the amount of 4.28 kilos must be deducted from 20 kilos so as to exceed the amount required as follows:

285.7	kilos, cotton seed meal
×.015	or (1.5%), per cent of potash in cotton seed meal
4.28	kilos potash.
20.00	kilos, potash required in one-ton mixture
−4.28	kilos, potash
15.72	kilos, potash, the exact amount required.

(*c*) Since kainit containing 12 per cent potash is to be used in the mixture to supply the 15.72 kilos of potash, the

amount of kainit required in one-ton mixture of fertilizer can be determined as follows:

For every 100 kilos of kainit it will contain 12 kilos of potash.

Therefore, 12:100::15.7:X or $\frac{100\times 15.7}{12X}=\frac{1,570}{12}$ or X=130.8 kilos kainit, the amount required in one-ton mixture.

IV. The amount of the different materials to make one-ton mixture of fertilizer whose composition contains 2 per cent nitrogen, 8 per cent phosphoric acid and 2 per cent potash will be as follows:

	Kilos
Cotton seed meal	285.7
Bone meal	530.7
Kainit	130.8
Filler	52.8
Total	1,000.0

The use of fertilizers.—The food nutrients which plants derive from the soil that the farmer is most concerned about are nitrates, phosphoric acid, potash, and lime. There are other elements used by plants but, as a rule, they are found in most agricultural soils in sufficient quantities. Each element of the plant food serves a different purpose in the building up of the plant. For example, nitrogenous substances serve to develop the leaf and stem of the plant. It should not be understood, however, that plants producing only leaves and stems only need nitrogen, but that nitrogen is more important to such plants than are the other elements of fertility; hence grass which is not grown for seeds requires a large quantity of nitrogen as compared with the other elements of plant food. Plants producing large quantities of starch or sugar, use large quantities of potash in the formation of this starch or sugar, hence such plants as sugar cane, cassava, potatoes, and rice require liberal quantities of potash. Plants producing seed, such as rice and corn, require large quantities of phosphoric acid. Lime is used by all plants more or less in building up the stem and body, the woody portion of the plant.

Application.—In some cases where a crop is forced specially the fertilizer should be applied to the soil in such a manner that the roots of the plants will come in contact with it as soon as they start to grow. Where crops are planted in rows, it is better to apply the fertilizer in the furrows before planting, or at the side of the rows soon after planting. It is much less expensive to apply the fertilizer before planting. Fertilizers may be applied with a drill drawn by cattle or carabao. Drills which distribute the fertilizers to one or two rows at one time

may be used. In case a drill is not available the fertilizer can be distributed very evenly by hand. In case the seed is to be sown broadcast over the surface, then of course the fertilizer may be applied broadcast and harrowed in. In most cases it is immaterial whether the fertilizer is applied long before planting. Such fertilzer as cotton-seed meal or other organic substances that are likely to ferment when they become moist, should be applied some days before planting, because if seeds come in contact with the fermenting substance they will rot. In the case of inorganic fertilizers there is no danger of the seed being injured, unless large quantities are used.

Certain fertilizers when mixed with other kinds react chemically resulting in the loss of available nitrogen or phosphoric acid, as the case may be. The following diagram would serve as guide to the farmer, in mixing fertilizers:

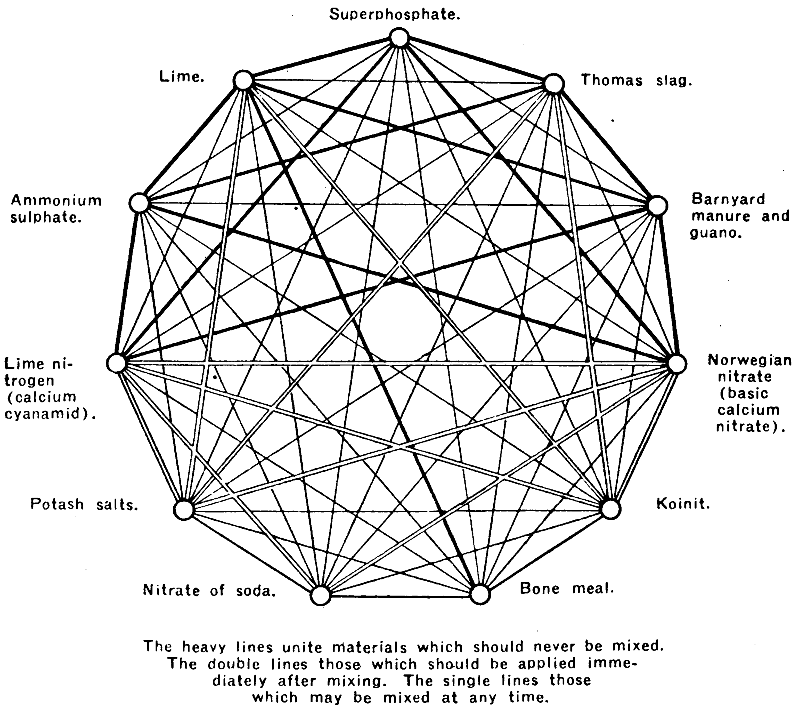


FIG. 5. Diagram indicating what fertilizer materials may and may not be safely mixed. The dark lines unite materials which should never be mixed, the double lines those which should be applied immediately after mixing, and the single lines those which may be mixed at any time.

REFERENCES

Yearbook of the United States Department of Agriculture (1918); pp. 186–190.

Vegetable Gardening by Ralph L. Watts (1919) pp. 54–71.

The Philippine Agricultural Review, Vol. IV, pp. 53–64.

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF AGRICULTURE
MANILA

[Circular No. 143]

DISPOSAL OF CARCASSES OF ANIMALS THAT HAVE DIED OF ANTHRAX AND OF THOSE DYING OF UNDETERMINED DISEASES

The organism (microbe) that causes anthrax will live in the soil for a long period of time—even for several years. Under certain conditions, it will also multiply there and cause a fresh outbreak of this disease. So the most important point in dealing with anthrax is to avoid contamination of the soil. All discharges from the sick animals must be destroyed either by burning or by disinfection. Good disinfectants are bichloride of mercury (corrosive sublimate) in solution of 1 to 1,000 or creolin in 3 per cent solution.

The most important point, however, is proper disposal of the carcass. Animals that have died of anthrax or any unknown disease should under no circumstances be cut open nor may any part of the carcass (such as hide, horns, hooves, etc.) be removed, since they are capable of spreading the infection. As soon after death as is possible, bury the animal in a grave not less than two meters deep. To avoid the danger of scattering the infection by moving the carcass it is desirable to dig the grave as close as possible to the place where the animal died. Of course the grave must not be dug close to a well, river, or other water course. If the grave cannot be dug where the animal died then great care must be taken in moving the carcass to the place of burial. All the natural openings of the body must be plugged up with cotton, tow, or cloth to prevent the escape of fluids. The sled used for transporting the carcass should be pulled by men in order to avoid the danger of infecting any animal which might be used for hauling the carcass. A pathway for the sled can be covered with dry rice straw several inches thick and the straw burned after the carcass has been taken over it. As soon as the carcass has been lowered into the grave the ground where it had been lying must be dug up to a depth of 4

or 5 inches and this soil thrown into the grave. This is to prevent infection from the contaminated soil. After the grave has been filled in, it must be disinfected with one of the disinfectants named above, or else a thick layer of rice straw spread over it and the ground for some distance around and burned. All ropes that have been used on or around the dead animal must be buried with it. The sled used for transporting the carcass must be well disinfected. The people who have handled the dead animal should also disinfect themselves and the clothing worn while in contact with the carcass.

POULTRY NOTES

On March 8, Mr. Go Tamco, a well-to-do Chinese merchant received from China a basket containing approximately 800 eggs. During the trip some of these eggs were broken and some were spoiled so that only 674 eggs could actually be used for setting purposes.

The Animal Husbandry Division of the Bureau of Agriculture seeing a good opportunity to determine the claims of several private parties that have informed the Bureau of their success in hatching a fair proportion of Chinese imported eggs, agreed to test these eggs. On March 10, 1923, the eggs were placed part under artificial incubation and part under natural incubation at Alabang Stock Farm. The result of this test was as follows:

ARTIFICIAL INCUBATION

[Buckeye incubators]

Number of eggs set	464
Number of eggs found infertile	196
Number of eggs with dead germs	76
Number of eggs with chicks dead in shell	82
Number of eggs that hatched	110

NATURAL INCUBATION

[Cantonese hens]

Number of eggs set	210
Number of eggs found infertile	101
Number of eggs with dead germs	13
Number of eggs with chicks dead in shell	51
Number of eggs that hatched	45

Considering the numebr of eggs set, this was a fair test of the possibility of hatching imported Chinese eggs that have been given a fair degree of care from the time they left the place they were purchased until they were set.

The majority of the chicks hatched are like the Cantonese chicks raised at the farm, though some are with black shanks and toes and a few are white. It is interesting to note that they seem strong and healthy and can be expected to live to maturity.

The following are a few pointers which should be taken into account by those who may wish to conduct the same experiment:

1. The longer an egg is held the weaker the germ becomes.
2. Exposing the eggs to drafts will cause undue loss of moisture that will weaken the embryo.
3. Thin shelled, irregular shaped and rough shelled eggs and those with translucent dots are less likely to hatch than a healthy looking normal egg.
4. A high or too low temperature while shipping will prevent germination.
5. Every precaution should be taken to keep the eggs clean and apart from spoiled eggs.

The Philippine

Agricultural Review

VOL. XVII THIRD QUARTER, 1924 No. 3

A QUARTERLY PUBLICATION

ISSUED IN ENGLISH BY THE
BUREAU OF AGRICULTURE

The Government of the Philippine Islands
Department of Agriculture and Natural Resources

Subscription rates: ₱2 (Philippine currency) or $1 (U. S. currency) per annum in the Philippine Islands and the United States and territories.
$2 (U. S. currency) per annum in foreign countries.

MANILA
BUREAU OF PRINTING
1924

(Entered at the Post Office at Manila as second-class matter)

THE PHILIPPINE

Agricultural Review

VOL. XVII THIRD QUARTER, 1924 NO. 3

TABLE OF CONTENTS

	Page
1. The Philippine Tobacco Industry—Suggestions for its Improvement	147
2. Turkey Raising, by Carlos X. Burgos	157
3. Agronomical Experiments Performed by the Plant Industry Division, Bureau of Agriculture, during 1923	167
4. Comparative Tests of Six Philippine Corn Varieties, by Francisco D. Marquez	195
5. Experiments on Vegetative Propagation of Tropical Fruits at the Lamao Experiment Station, by F. G. Galang and A. Elayda	203
6. Variety Test of Cabbage, by E. K. Morada	207
7. Administrative Order No. 44	215

ILLUSTRATIONS

Facing page—

PLATE I. Bronze tom with newly weaned young turkeys. It will be noticed that there is a pure bred off-colored poult very much alike the light colored native turkeys 160
II. A two-year old Bronze tom..... 162
III. A native turkey hen..... 164
IV. (a) Bohol White..... 196
(b) Cebu White..... 196
V. (a) Moro White..... 196
(b) Baluga Yellow..... 196
VI. (a) Cagayan Yellow..... 198
(b) Calamba Yellow..... 198

TEXT FIGURES

Page

FIG. 1. Brood Coop for turkey hens and poults..... 162
2. The completed bale showing method of wrapping, binding, and tagging..... 221
3. Cloth tag showing manner of labelling..... 223

THE PHILIPPINE TOBACCO INDUSTRY—SUGGESTIONS FOR ITS IMPROVEMENT [1]

For the sake of convenience, this report has been divided into four parts, the first embodying agricultural features of the industry, the second dealing with the classification and grading of leaf tobacco, the third dealing with the marketting of the product, and the fourth containing the recommendations of the various committees. It will be noted that while the recommendations are not by any means exhaustive, yet they are considered to be steps in the right direction, inasmuch as they will not disturb local conditions by a sudden change from former tradition and practice to what are accepted to be the most advanced methods in the industry. Consequently, the recommendations of the committee should be regarded from the point of view of the gradual preparation of the various elements in the tobacco industry in the Philippine Islands to accept the more advanced processes observed in other tobacco growing regions of the world.

I. AGRICULTURAL FEATURES

General Conditions in the Cagayan Valley.—The planters plant heterogenous strains of tobacco which produce types lacking uniformity. They do not sterilize the seed beds to prevent the development of damping-off fungus and insects which destroy the plants. In transplanting, they generally pull the plants carelessly and they space them too far apart, thus producing coarse leaves; they are rather indifferent to the productions of sound

[1] Report of the Tobacco Committee designated by His Excellency, the Governor-General of the Philippine Islands to make a survey of the tobacco industry with the end in view of improving actual conditions. The Committee is composed by Col. G. T. Langhorne, Chairman, Antonio Carag, Provincial Governor of Cagayan; Mariano Manas Cruz, Chief, Plant Industry Division, Bureau of Agriculture; Ventura Guzman, Provincial Governor of Isabela; Don D. Strong of the Bureau of Agriculture; Adriano Hernandez, Director of Agriculture; A. W. Prautch, Chief, Rural Credit Division, Bureau of Agriculture; Juan Posadas, Jr., Collector of Internal Revenue; Geo. R. Summers, Assistant to the Director of Education; Fidel A. Reyes, Director, Bureau of Commerce and Industry; Jacobo Fajardo of the Philippine Health Service, and Carlos Fernandez of the Tabacalera Company, members.

leaves; they usually top their plants heavily in spite of good growth; they don't generally harvest by priming, i. e., they don't harvest as soon as the leaves mature; they cure leaf tobacco in haphazard way, sometimes not only wilting the leaves but completely drying them in the sun; and they do not space the leaves in palillos properly for curing purposes. There is at present comparatively a small number of regulation curing sheds in use making the proper curing of leaf tobacco difficult, while the mandalas are not generally prepared properly to cause the leaf tobacco to ferment completely without spoiling its quality.

In the face of these conditions, we find certain difficulties encountered by the planters which must be remedied for the betterment of the tobacco industry in the Valley.

Difficulties.—The planters, for instance, are not induced to produce tobacco of better quality because buyers do not generally discriminate as regards the quality of the material they buy and consequently are not prone to pay good prices; and they are reluctant in curing leaf tobacco properly, as they do not receive the corresponding price for better cured tobacco. In the case of building regulation curing sheds, it has been found out that not every farmer has the means of putting up such a curing shed for his use; for instance, a small planter cannot put up a shed costing him at least ₱150 when his harvest would only sell for an average of ₱240. Moreover, in the Cagayan Valley, the curing sheds are mostly destroyed annually by the typhoons or floods and it is difficult to get the specified kinds of timber because of the distance of the forests from the tobacco fields. Another difficulty met with is the lack of faith of the average grower in the publications on tobacco issued from time to time, since he regards them as purely theoretical. Furthermore, the farmers on the whole lack money that might enable them to visit experiment stations or attend tobacco conferences; while, on the other hand, the Bureau of Agriculture at present has only two agricultural extension agents due to the retrenchment policy of the Government and they can hardly attend to the agricultural problems of the farmers.

II. CLASSIFICATION AND GRADING OF LEAF TOBACCO

Administrative Order No. 35, as amended by Administrative Order No. 54, of the Bureau of Internal Revenue, governing the classification of leaf tobacco has been carefully gone over by the subcommittee on grading. It was found that the classification of leaf tobacco therein contained is substantially the

same as the classification in vogue during the Spanish tobacco monopoly.

The passage of Act 2613 placed in the hands of the Government an undertaking "to improve the methods of production and the quality to tobacco." This undertaking includes the matter of leaf tobacco classification. To bring about proper classification, the regulations referred to above have been promulgated. The tobacco dealer has been, and is actually the one principally concerned in the compliance with these regulations, but the anomalies which have developed and which need to be eradicated for the benefit of all demand that the said regulations should extend to the tobacco producer as well. Two ways are therefore submitted by which proper tobacco classification by the producer can be effected, i. e., (1) by compulsion, or (2) by educating the farmers in the advantages of coöperative associations and by making such associations exert their persuasive influence in bringing home to the growers the value of proper grading.

As stated above, the classifications of leaf tobacco is not applicable to the producer who sells his crop to a registered tobacco dealer at the place of production. This circumstance has led to the practice of many planters to dispose of their tobacco "in palillos" without being classified, and thus the classes of the tobacco sold are uncertain. The growers complain that the buyer is trying to place him at a disadvantage by offering a low price for his tobacco while the latter believes that he is being misinformed by the former as to the classes of his crop. Proper grading will eliminate this apparent misunderstanding. There are marked advantages for the grower if he undertakes the classification of his tobacco; (*a*) the tobacco is in its most appropriate form for classification while it is in his hands; (*b*) he can demand better prices for his tobacco properly classified; (*c*) the buyer will be induced necessarily to pay good prices on classified tobacco as he would know just exactly what he is buying and furthermore he would be saved the trouble of having a classification made, and (*d*) the present mutual distrust between the planter and the buyer would be eliminated.

The actual practice of letting the buyer take care of the classifications is not desirable. After the tobacco is purchased by him, it needs to be handled several times. It is transported to his warehouse in carts, piled there, and after this operation, it is again removed from the piles and rehandled for its classification. This process causes considerable breakage of leaf and therefore entails considerable loss on the part of the buyer.

Besides, the buyer has to incur additional expenses for labor in order to make this classification. The advantages in having the planter undertake the classification of his tobacco before he sells it are therefore evident.

The work of the Government in endeavoring to effect proper tobacco classification, in so far as the grower is concerned, has been limited only to persuading him to classify his tobacco before selling it. One of the purposes in adopting a solution for the discord between planters and buyers is to do away with certain anomalous practices in connection with the purchase and sale of tobacco.

MARKETING

Description of method.—Briefly, the marketing method in the Cagayan Valley is as follows:

As a general rule, all large buyers of tobacco employ agents in the tobacco producing districts. These agents commence work before the tobacco crop ripens. They go to the fields and size up the probable quality and quantity expected to be gathered by each planter and they report the prospects to their respective principals. So, the said buyers can more or less figure out what quantity of tobacco they can secure from each district. After the crop is gathered and the planter is ready to sell it, the agents or brokers go to the said planter and offer a certain price for his tobacco. It is the broker that fixes the price for the planter's crop and upon the agreement of the latter, the transaction is closed and the buyer issues a "papeleta" to the grower with the condition that the latter shall transport the tobacco to the warehouse of the former's principal.

The agents or brokers claim that upon their inquiry the grower does not disclose the true quality of his tobacco so that a feeling of distrust is entertained by him against the planter. However, on certain occasions, when competition to buy tobacco is keen the buyers or brokers are not guided by the quality of the tobacco for it is their purpose to purchase as much tobacco as they can.

On the other hand, the grower is always distrustful of the buyer in view of the fact that he is of the belief that the said buyer is always making efforts to place him at a disadvantage by offering a very low price for his crop. Such feeling of distrust becomes more serious upon the delivery of the tobacco by the grower at the warehouse designated. The grower alleges that in most cases he does not receive the price originally offered him by the buyer's agent, for his tobacco, for when he reaches the warehouse his tobacco is reclassified and the price appearing in

the "papeleta" issued him disregarded. Such reclassification always results in the reduction of the price of the tobacco, and the principal buyer refuses to buy it if the grower does not accept the second price offered. The grower claims that it is then when he is taken advantage over because at any rate he is obliged to dispose of his tobacco in view of the necessity to secure money for his family's needs. Furthermore, the difficulty of transporting back home the tobacco obliges him to accept the second price offered.

The "papeleta" system.—Under the system of buying on the "papeleta" it is alleged that the buyer acquires the right to buy the grower's tobacco upon an advance of a nominal amount of money. Upon the issuance of the "papeleta" the buyer believes that the grower assumes the obligation to deliver the tobacco purchased and not sell it to any other buyer.

The grower, on the one hand, believes that by the use of the "papeleta" he is placed at a disadvantage. As pointed out above, he is required to take the tobacco for which a "papeleta" has been issued to the warehouse of the buyer, but upon delivery he, in most cases if not in all, suffers a reduction of the price of his tobacco. Consequently, he complains against the "papeleta" method as prejudicial to his interests.

The buyers on the other hand claim that contracts by means of the "papeleta" are recognized by the courts of justice to be legal, and for this reason the said buyers depend upon the term of the "papeleta" in enforcing their rights if the planter does not comply with his obligation to deliver the quantity and quality of tobacco contracted for. It is not strange, however, that upon delivery, the quality of the tobacco delivered differs from that appearing on the "papeleta." This is due to the fact that the contract was not based upon the actual quality of the crop but merely upon an estimate. Under the circumstances, the planter is convinced, as above indicated, that he is the one prejudiced in the last analysis. If the "papeleta" is a valid document as an evidence of a contract, the terms thereof should operate equally upon the contracting parties, that is, upon both the buyer and the grower, and thus, the buyers will become more careful in indicating the proper quality of the tobacco on the "papeleta" issued by them.

Pernicious effect of present method.—The practice as indicated in the foregoing paragraph governing the purchase and sale of tobacco have, as a consequence, developed the present situation in the Cagayan Valley. There is a continuous discord between

the buyer and the planter with the former having an apparent advantage because of his intelligence and financial means.

Under the present method of marketing there is absolutely no incentive for the planters to produce better leaf. The buying and selling of assorted lots (uno con otro) generally prevailing in the Valley is not conducive to the production of better leaf, as no premium is paid in quality.

It is a fact that the tobacco goes through many hands before it reaches the manufacturer or exporter. As a consequence, the compensation of the intermediaries is added to the price of the tobacco. Their elimination will, it is believed, result to the benefit of the planters as they will get good prices for their tobacco, as well as the buyers for the reason that they will not need as much outlay as they employ at present.

IV. RECOMMENDATIONS

AGRICULTURAL FEATURES

(*a*) To secure the coöperation of the provincial and municipal officials, and of the officers and employees of the Bureau of Internal Revenue, Commerce and Industry, Education, and Forestry, the Philippine Health Service, and the College of Agriculture of the University of the Philippines for the proper functioning of the Bureau of Agriculture, in connection with the work on cultivation, curing and fermentation of leaf tobacco.

(*b*) To provide funds for traveling and other incidental expenses of non-government employees visiting the tobacco stations of the Bureau of Agriculture or attending a tobacco conference in a barrio or town within the tobacco region, from the Tobacco Inspection Fund of the Bureau of Internal Revenue under Act 2613.

(*c*) To employ College of Agriculture graduates as tobacco inspectors (Tobacco Extension Agents) for the different tobacco regions of the Cagayan Valley. These tobacco extension agents are to be given at least ₱1,200 per annum each from the Tobacco Inspection Fund under Act 2613 of the Bureau of Internal Revenue.

(*d*) To issue a cathechism [1] and publish posters on better leaf tobacco production in English, Spanish, and native dialects.

---

[1] A cathecism on leaf tobacco production may be obtained free of charge by applying to the Director of Agriculture, Manila, P. I.

(*e*) To make a more rigid campaign for better leaf tobacco production among the farmers, as follows:

(1) To use better strains of tobacco producing an ideal type of leaf, not less than 30 centimeters long, wide, with rounded tip and base and with thin veins widely separated and forming either an obtuse or a right angle with the midrib, and with a light (*claro*) color when properly cured and fermented.

(2) To sterilize the seedbed by heating, before preparing it for planting, either by burning thrash over the surface of the soil or by pouring hot water over it.

(3) To advise the planters to limit their crop to what can be properly handled and plant at least 1/10 of it at closer distance, viz.: in hills 50 centimeters apart in rows 75 centimeters to 1 meter apart, depending upon soil fertility and to transplant the plants together with balls of earth so as not to interrupt their growth in the field and thus producing finer leaves; to use more patience and labor in controlling leaf-eating insects such as tobacco worms; to take better caution in topping the plants; and to harvest the leaves in the right stage of ripeness and by priming only.

(4) The curing of leaf tobacco in regulation curing sheds should be made more general. However, the existing Government regulations relative to the curing of leaf tobacco and the building of curing sheds should be amended to the effect that leaf tobacco may be partially cured in the sun (for wilting purposes only), the length of time or number of days to depend upon the texture of the leaves and the weather conditions. As to the length and width of the tobacco curing shed and the kind of materials to be used in building it, the matter is to be left to the discretion of the growers. The floor of the curing sheds should preferably be made of tamped clay or bamboo.

The building of community curing sheds may be necessary for those planters who can not build one for each.

(5) Leaves for curing should be put in "palillos" each to contain not more than 100, preferably 50 leaves, allowing a finger space between the leaves.

(6) The piles or mandalas should be 5 meters square and 3 meters in height, whenever possible. The mandalas should be taken down or undone for the first time as soon as the temperature of 38° C. is reached, and then rebuilt. The throwing down and rebuilding to be repeated when the temperature gets up to 42° C., 46° C., 50° C., and finally to 52° C. or when the fermentation is completed. In this work, a thermometer is indispensable unless the work is to be done by a very experienced man.

(7) The following sanitary measure should be observed:

Mandalas should not be piled except on floors built about 2 feet from the ground and covered with clean mats.

Premises wherein baling is done must be maintained at all times in clean and sanitary condition.

(*f*) It is believed that a course in tobacco culture, classification, and grading should be given in the public schools established in the various tobacco-producing regions.

CLASSIFICITION AND GRADING

(*a*) To amend subparagraphs 1 and 2 of subsection (*b*) of section 6 of Administrative Order No. 35 so as to read as follows:

"(1) *Pinoñgos.*—The leaves are taken from the pole on which strung for drying, and classified [as to] IN UNIFORM size, soundness, color, and texture, and [leaves of the same classification] gathered into bunches (pinoñgos) of [not more than 50] TWENTY leaves to the bunch [the number depending upon the size of the leaves] and tied together with twine or fiber at the stems. If the packer so desires, he may, before baling, further gather [four] FIVE pinoñgos together, and tie them at the stems, in the middle, and at the tips, forming what is known as a 'carrot.'

"(2) *Old-style hand.*—The leaves are taken from the pole on which strung for drying and classified [as to] IN UNIFORM size, soundness, color, and texture.

"The leaves are then folded along the midrib so that the under side (dorsal aspect) of the leaves faces out, and TEN leaves of the same classification gathered into bunches (*manojitos*) and [a number] TEN of these bunches tied together into a hand in such a manner that the midribs are exposed. Each hand is tied at each end and in the middle with twine or fiber."

(*b*) Likewise, section 5 of Administrative Order No. 35, as amended by Administrative Order No. 54, should be amended by the addition of paragraph (*f*) to read as follows:

"(*f*) Leaf tobacco before being sold in the Philippine Islands, either for domestic use or consumption or for export, must first be classified in accordance with these regulations; *Provided,* however, that the classification herein required to be made shall not be understood as prohibiting the grower to sell leaf tobacco in 'palillos' by the lot once such tobacco has been duly classified."

MARKETING

To establish coöperative marketing associations.

Among the beneficial effects of coöperative associations will be: First, the gradual and, in the end, the complete elimination of "corredores" or brokers; second, the abolition or modification of the "papeleta" system; third, all transactions will be based on classification; fourth, general improvement of the tabacco industry through scientific and educational campaigns undertaken by all associations; fifth, extension of credits based on crops or real property, thus doing away with usurious advances on crop liens; and sixth, termination of the continuous discord between buyers and planters with the consequent cultivation of the desirable mutual relations between these two elements.

It is believed that the buyers will be benefitted by the operation of coöperative associations. Where at present they have to deal with hundreds of small planters, under the coöperative plan they

would deal with only one association in every town where they do business. In this way, the buyers will save time and patience, the whole procedure will be more in accordance with modern business methods, and there will be less litigation for the buyers will be dealing with responsible associations.

The interests of the tobacco buyers and the planters are closely intertwined. The former desire good tobacco and fairly abundant supply of it, but the latter have but a limited production under present conditions. There is no doubt that coöperative associations will improve conditions in the Cagayan Valley; therefore, the coöperative movement ought to merit the support of the tobacco buyers. However, objection is interposed by the tobacco buyers on the ground that in associations of this kind usually a few dishonest officials take advantage of the rest. But it is submitted that with the associations projected by the Bureau of Commerce and Industry strict Government supervision through the district auditors or their deputies, or through the provincial treasurers or their deputies, is contemplated. Furthermore, the Bureau will have traveling agents who will see to it that those associations are managed properly.

In order to operate coöperative associations successfully, it is believed imperative to enlist the coöperation of the big buyers. Such coöperation can be secured in view of the fact that the operation of the said associations is not aimed at the beneficial results they bring to the growers only but also at the convenience and advantages afforded the buyers and the benefit of the tobacco industry in general as well.

TURKEY RAISING

By CARLOS X. BURGOS, *Animal Husbandman*

The purpose of this article is to satisfy in some way the increasing demand for information on the subject of Turkey Raising which comes to this Bureau from the public.

STATISTICS

According to the figures obtained from the census of 1903 and from that of the 1918 which are given below, there was in 15 years an increase of 18,000 turkeys in the Philippines and the average prices per bird was ₱4 in 1918 as against ₱3 in 1903.

Census year	Number of turkeys in the Philippines	Value	Killed yearly for table use
1918	27,754	₱103,859	7,129
1903	9,201	27,878	2,456

The 1918 Census also gives the following provinces with over 1,000 head of turkeys:

Province	*Number*
Bulacan [1]	4,851
Rizal [2]	3,038
Pampanga [3]	2,536
Iloilo [4]	1,914
Pangasinan	1,869
Cagayan	1,462
Occidental Negros	1,300
Manila	1,218
Ilocos Norte	1,098

[1] The municipalities of Hagonoy and Paombong having 1,373 and 609, respectively.
[2] The municipality of Binañgonan having 1,726.
[3] The municipality of Masantol having 534.
[4] The municipality of Janiway having 686.

It is interesting to note that Luzon Island far surpasses the other islands in this production.

THE NATIVE TURKEY

The Spanish writers of the early occupation of the Philippines do not mention in their writings that turkeys were found in the Islands, although, they mention other domestic fowls and animals. It is therefore most likely that the present day Philip-

pine turkey was only introduced by the Spaniards from Mexico as the turkeys are supposed to be of American origin and Spain controlled these Islands largely through that dependency.

The Philippine turkeys are very small as compared with the Bronze turkeys but most of the former, the dark ones, have a close resemblance in color to the latter breed.

A comparison of the weights of turkeys made at the Alabang Stock Farm gave the following averages:

	Bronze	Native	Mestizo bronze
	Kg.	*Kg.*	*Kg.*
Toms	12.5	5.8	7.2
Turkey hens	5.4	3.4	4.5

The small size of the present day Philippine turkey may be due to continuous in-breeding of unselected stock and inadequate feeding since their introduction.

CARE OF THE TURKEYS

The usual practice here of the average person who owns some turkeys is to let them run in the same yard with other fowls and to let them roost on the same perches or trees. In this way they keep fighting all the time and unsatisfactory results are obtained. This practice is not so bad if there is plenty of range and there are separate roosting places; but better results could be had if turkeys are kept separate from other stock.

To begin with, it is best to select a place that drains well during the rainy weather. A sandy loam soil with the necessary ditches will do well although hilly sections are best, provided of course, that there is a wide run that is rich in grasshoppers and other insects and tender buds. Turkeys also relish seeds of weeds and grasses. Wide, semi-wild conditions as these will not only reduce cost of care and feed but will prevent diseases in the flock.

Adult turkeys may be allowed to roost in the open but during stormy and rainy nights, it is always hard on them so it is a good system to have a shed where the turkeys may roost and be protected from the rain. An open shed surrounded with poultry wire netting will not only protect them from theft but will also serve to protect them from the Musang (*Paradoxurus philippinensis* Jourdan) and other destructive animals. If not confined at night, they soon become wild. Confining of turkeys in small inclosures most always is discouraging and should not be adopted.

For this purpose a fair-sized orchard, say from 3,000 to 4,000 square meters would be a satisfactory place for one gobler and eight hens. There will be plenty of range and shade for them and they will serve to reduce the insect pests. A hog-proof wire fence, one and one-quarter meters high, will be sufficient to keep them in. With good every-day care, turkeys will keep in thriving condition and will give good returns to the one in charge of a flock.

The adult turkeys should be fed at least every afternoon with a mixture of equal parts of a variety of whole grains, as palay, corn, Momungan edible adlay, Baso sorghum, mongo, peas, cadyos, etc., and should have free access at all times to grit, charcoal, pounded oyster shells and clean drinking water. Table and kitchen scraps can also be used to advantage. Instead of throwing into the garbage pail the surplus rice, the potato, banana and papaya peelings, the cabbage, pechay, and lettuce leaves, the yamas (from coconuts), the meat, fish and shrimp scrap, and all other still useful waste including clam and oyster shells (the last two should be pounded into small pieces and placed in boxes) feed them to the turkeys.

In Rizal Province many people feed the adult turkeys with all they will clear of a mixture of two parts tiqui-tiqui (rice bran) and one part finely chopped banana trunk, morning and afternoon, and allow the birds to balance their ration from whatever insects and weed seeds they find on the range. Palay and corn are seldom fed.

MANAGEMENT OF THE FLOCK

One vigorous tom will do for as many as 10 hens, but one male to six or eight females is the best on the average. For one hectare of land from 20 to 30 hens may be kept.

Do not breed turkeys less than a year old.

In selecting, strength and vigor are the first points to consider as poor parent stock will mean weak germs and consequently weak poults. The head should have a clean and healthy appearance. The form must be compact and the breast and body long and deep. Sturdy shanks and toes and strong-sized bones indicate physicial vigor.

To avoid in-breeding, it is a good policy to have new toms at least every three years from far off farms that are not related to the flock. This, however, is a somewhat dangerous procedure for it may bring disease into a flock but it is up to the

person buying to make sure that there is no disease where he gets his new tom and to take precautions by quarantining the new comer in a separate compartment for sometime about 2 to 3 weeks. The best hens raised on the farm should be reserved for breeding and should not be sold just because a good price is offered for them. If this is not done, after a while there will be only inferior stock left that will produce weak poults which will easily become sick and die. On the other hand, all the undersized females should be disposed of as it must be remembered that size and physical vigor come largely from the females. The toms need not be over-large, a medium sized one should be preferred as this would serve to protect the turkey hens during breeding.

Mating.—In small flocks it is better to have only one male to insure fertility of the eggs. One good mating will be sufficient to fertilize the whole clutch of eggs the turkey hen will lay. If the service was not good, due to the disturbance by another male, the eggs will likely be infertile, as the female will afterwards pay him little attention and be more busy looking for a nesting place. It is a good idea to trim the nails of the toms in order to protect the backs of the females while mating.

Turkey hens always prefer secluded places and for this purpose empty barrels will do if placed on their sides under brush and shady places. The "tikles," a wide mouthed basket used in Bulacan, is also good and cheap. Put enough rice straw in them and try to protect them from rain. The turkey hens will soon adopt them.

The hens lay, on the average, about 16 to 20 eggs but, of course, 15 eggs for each sitting is sufficient and the difference of this number should be taken out unless the eggs are put under chicken hens; as is customarily done in this case, give each chicken hen not more than nine eggs. The eggs laid should be gathered daily and precautions should be taken not to let the turkey hen discover it is being done. Only leave the last egg or better still use one or two China eggs. The incubation period of turkey eggs is 28 days on the average.

As soon as the turkey hens sit, every precaution should be taken to protect the eggs from crows and snakes and rats. Also a new nesting material should be provided. The turkey hen should be dusted twice a week with some good lice powder in use as sodium flouride, to protect the poults when they hatch. Furthermore, close supervision should be exercised over the nest once in a while to see that there are no mites and lice in it. The eggs should be tested on the 10th day by candling in order to separate the infertile ones and those that may have dead germs.

Bronze tom with newly weaned young turkeys. It will be noticed that there is a pure bred off-colored poult very much alike the light colored native turkeys

In the Alabang Stock Farm where turkeys have been raised since July 8, 1921, it has been observed that turkeys lay eggs throughout the year although during the rainy weather (June, July, and August, there is a marked decrease in the number of eggs laid—it is at this time when most of the hens are molting.

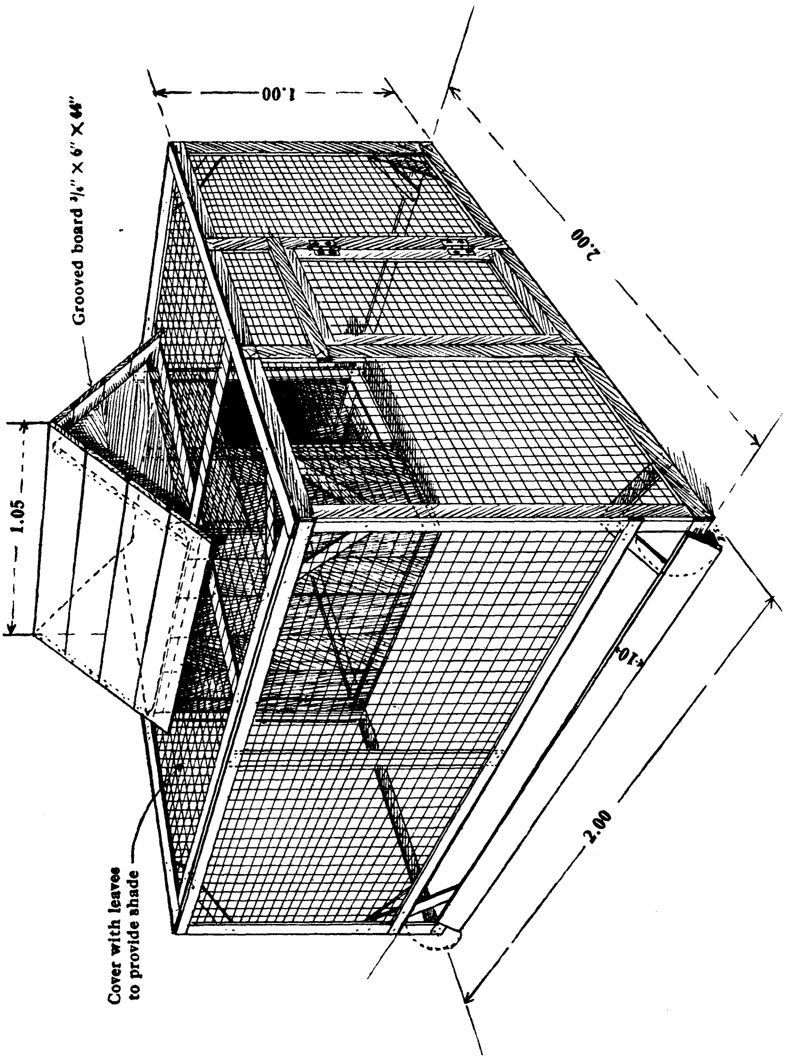
CARE OF THE POULTS

The most important thing to know in the raising of poults is that they need good care and attention. For the average person who can give only a few minutes every now and then but neglects his flock most of the time, failure with a big "F," is the most he can expect. Shiftlessness won't do. Natural love for the work and good will to attend to it at regular intervals and daily, too, have been responsible for the success of the successful turkey raisers.

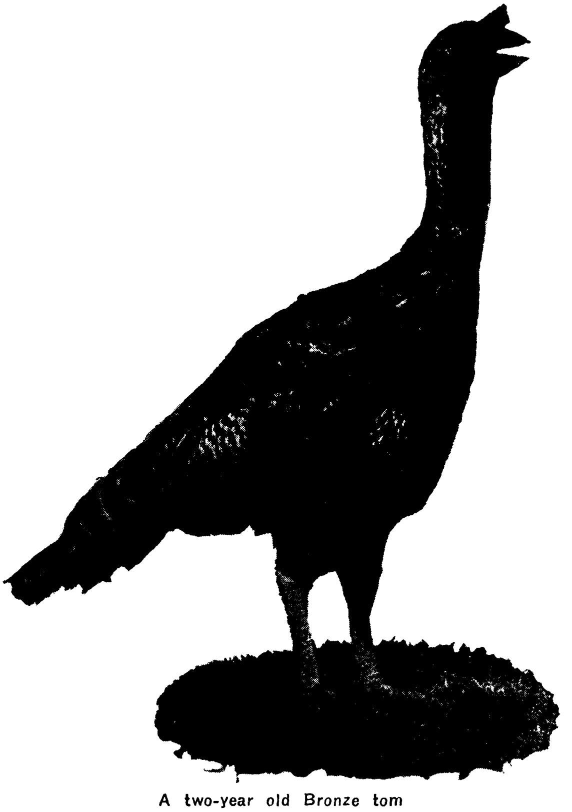
A brood coop that is roomy enough and will protect the brood from rain, sunshine, and vermin should be built for every turkey hen—Figure 1 illustrates one that may serve as a model. This coop should be strong but light enough to facilitate moving from place to place daily or every two days so as to keep the floor clean. Always select a dry place for it. Keep the mother hen in the coop to protect the poults from getting wet. In favorable weather and when the poults are a week old or over, the big door may be opened to allow the hen and the brood a free range. It is, however, better to wait for the dew to dry before turning the poults outdoor. During uncertain weather keep them in the brood coop. It must be remembered that rain is fatal to poults less than one month old. Examine the coop often for insect parasites as these will weaken and kill the poults. The ordinary small red ants are one of the worst enemies of young poults. Musangs, iguanas, snakes, crows, hawks will prey on the poults if not protected.

Feeding the poults.—Do not feed the poults the first two days as they have enough food in their system to keep them in healthy condition.

On the third day give them finely cut green feed, a little bread and milk and hard boiled egg, chopped fine, shell and all. Clean water and coarse sand may be given to them also. It must be remembered that the poults are not as intelligent as chicks are and they must be keenly observed during the first few feedings. See that they know how to eat as sometimes they will seem to be picking when in fact they are not and have only an empty crop. Hand feeding of poults needs practice but it is



Brood coop for turkey hens and poults



A two-year old Bronze tom

the best as it assures that every poult eats and in this way it gives every one a good start. Up to three weeks of age, feed four or five times daily any of the following:

(1) Hard boiled eggs, chopped fine, mixed with three to four times its bulk of bread crumbs and moistened with milk. Give fine-chopped onion tops and lettuce leaves.

(2) Stale bread soaked in milk and squeezed dry, mixed with moistened common chick feed consisting of 3 parts "binlid," 7 parts tiqui-tiqui, 2 parts ground mongo, one part copra meal, and 1 part ground corn. One part steel-cut oats or one part ground adlay is a good addition.

(3) The general practice in these Islands is to feed the 2 to 4-day-old poults with a little coarse ground black pepper to make them feel warm. The main food is warm cooked rice and "alamang" (small shrimps) fed every two to three hours. One-half liter of "alamang" being sufficient for 20 poults. At about 8.30 to 9 a. m., they are allowed free range.

When feeding poults the following points should be remembered:

Do not feed sloppy food.

Do not overfeed but do not under-feed.

Always feed on clean boards or wooden trays and never on the bare ground, and keep always, where it is accessible, finely broken wood charcoal, grit and water.

The fourth week only chick feed may be given 3 times a day but they should be allowed free on the range. A little finely cut fresh meat or small fish and shrimps should be given when not allowed free range.

From the ninth week and over they should always be on free range. The morning feeding may be omitted. Give scratch grains late in the afternoon such as equal parts of palay, corn, sorghum, Momungan adlay, and mongo. Remember that a variety of grains is good for proper development.

In changing from one food to another make the change gradual.

III. MARKETING

During Christmas and Thanksgiving, and other important holidays, there is always a demand for turkeys and there are very few feasts in Manila where a stuffed turkey is not an important course. The price paid for turkeys is from ₱3 to ₱8 depending on condition and size. At present no pains are taken to have the market turkeys fed and properly fattened for table use.

The best time to fatten the young turkeys for the market is when they are about eight months old. They need not be penned. All that is necessary is to feed them three times a day in increasing amounts until they are fed all that they will consume of equal parts of corn, palay, and, if available, sorghum and Bukidnon adlay. One month feeding this way should put them in condition for the market. They will be easier to sell and surely would sell at better prices if fattened than if not.

Turkeys may also be caponized like chickens. They become quieter in disposition and less liable to range to distant places. In 1921 three seven-months old male turkeys were caponized at the Alabang Stock Farm to determine if there would be more improvement with regard to weight. The result after 1½ months showed only a small difference in favor of those caponized. All three at the beginning of the experiment weighed 15.5 kilograms and at the end they weighed 21 kilograms a difference of 5.5 kilograms.

Experiences at the Alabang Stock Farm show that the best hatching months for turkeys are during December and January. This will mean that poults hatched at this period would be over ten months old for the Thanksgiving and the Christmas holidays.

DISEASES AND PESTS

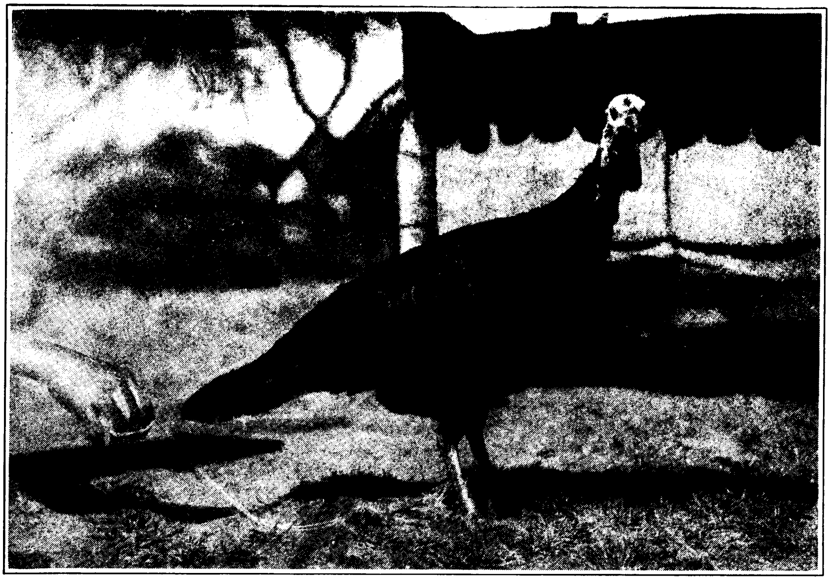
Turkeys are subject to practically the same diseases as chickens and reference may be made to our Circular No. 94, regarding them. However, mention will be made here of the most common ailments affecting turkeys.

White diarrhea.—This disease is caused by a germ called *Bacterium pullorum* that is transmitted from one poult to another through food and water and even by the mother through her ovaries if she happens to be infected. The poults die at the age of one to three weeks.

Treatment.—There is no reliable cure for this disease so prevention is the best remedy. Be sure that your grounds and fowls do not have it. If the poults have it, disinfect daily the premises where they are, using a strong solution of any disinfectant. Disinfect also the water and feed troughs before every feeding. Add a little potassium permanganate to the water to color it pink and feed the turkeys only cooked rice with chopped hard boiled eggs and a little black pepper.

According to some authors keeping a constant supply of some fresh sour milk is a good food to give to poults. This may be tried by those who can have milk without much expense.

Chicken pox ("Bulutong"—Tagalog name).—Chicken pox



A native turkey hen

attacks poults usually at the age of one to three months, is very contagious and causes death among them. The poults become full of red and later black nodules in the head and also the body.

Treatment.—The treatment that has been found best to help in curing this disease is by painting every chicken-pox nodule with tincture of iodine every night. At Alabang Stock Farm when chicken-pox appears the treatment is to dip a stick with cotton into clean water and then with the moist end pick one or two crystals of potassium permanganate. This is applied directly on the nodules with success. Separation of the sick ones from the healthy ones should be done at once to prevent the spread of the disease in the flock.

Enterohepatitis (known as "peste").—This disease is the most injurious to turkeys especially to adults or nearly mature ones. In the United States, it is commonly known as blackhead for in the course of the disease the head often becomes dark blue or nearly black.

The cause of the disease seems to be a parasitic protozoan (*Amoeba meleagris*) that leaves the body of the sick bird with the discharges of the alimentary tract and thus infects other turkeys. Diarrhea is nearly always a constant symptom. The ceca of the dead are inflamed and the liver large, showing necrotic yellowish-green areas.

Prevention is the best cure. Frequent disinfection of the houses, yards and the feeding and water troughs and destruction by fire of the sick and dead birds are necessary. Confine the turkeys in a small inclosure. Add some potassium permanganate into their drinking water to color it pink. Feed them only with a mash feed or better warm cooked rice and add to this, Abbot's sulpho-carbolate compound, a tablet to every four adult birds.

Do not keep turkeys and chickens together in the same yard as chickens have been found to be carriers of the blackhead organism without themselves being affected by it.

Pneumonia.—This disease of the respiratory system occurs frequently soon after a heavy rain during the hot days of July and August. The affected ones breathe rapidly, look dejected are not inclined to move about. There is profuse thick salivation that makes breathing difficult.

Prevention.—Putting the affected birds in dark warm but well ventilated boxes and cleaning the mouth with cotton to remove the thick saliva will sometimes save those that are not seriously affected. Feed small balls of warm cooked rice until recovery.

Lice and mites ("kutu" and "hanip"—Tagalog names).—Lice live upon the feathers, epidermis and secretion of the body of the host. Their eggs or nits are laid on the barbs of the feathers. They irritate and make the poults uncomfortable.

The mite sucks the blood of its host usually at night and lives in the cracks and crevices of the nests and perches where they lay their eggs and multiply. The chief danger from these pests is after the turkey eggs are hatched.

Prevention.—Dust the hen with insect powder twice a week during the incubation period. To the poults affected, rub a little lard upon the head, throat and under the wings. See that the nests and nesting materials are perfectly free from any lice and mites at the start of the hatch and during incubation. Make sure that the brood coop is also free from them. Use pure kerosene to paint the cracks and crevices in the brood coop as this will destroy the mites and even the eggs of these animals.

A cheap lice powder as that used at Alabang Stock Farm, Rizal may be prepared as follows: Take 3 parts gasoline or kerosene, and 1 part pure carbolic acid or creoline—mix together and add to it enough plaster of Paris to take up all the moisture. Powder the birds under the wings, in the fluff around the vent and on the ventral side of the body. When not in use the powder should be placed in well closed containers.

Ants and their prevention.—Ants are known to cause death of many poults especially when less than a week old. The best remedy is to keep the premises clean and not to allow food particles to remain long on the boards or feed troughs. The ants' nests should be destroyed when found.

ACKNOWLEDGEMENT

Due acknowledgement is here given to the invaluable suggestions made by Mr. Alfonso Tuason, Chief of the Animal Husbandry Division, Mr. Jose G. Guevara, Supervising Animal Husbandman, Mr. Ezequiel Alcasid, Superintendent of the Alabang Stock Farm, Mr. Felix A. Alcasid, Poultry Foreman at the Alabang Stock Farm, Messrs. Policarpo Padlan and Ambrosio Lontok, Agricultural Extension Agents, Dr. Francisco M. Fronda, Instructor in Animal Husbandry of the College of Agriculture, University of the Philippines and Dr. Bienvenido Gonzales, Head of the Animal Husbandry Department of the College of Agriculture, University of the Philippines.

AGRONOMICAL EXPERIMENTS PERFORMED BY THE PLANT INDUSTRY DIVISION, BUREAU OF AGRICULTURE, DURING 1923

LOWLAND RICE

Special variety test.—The multiplication test was carried on at Alabang, to raise seed material for the Bureau coöperators, and to enable the station concerned to judge the merits of the choice varieties when planted in a more or less commercial way. Sixty varieties were planted for this purpose.

A partial list of these varieties is presented below, merely to show their relations, the yields being in all cases below normal.

Variety name	Yiled in kilos per hectare
Quinatia I	2,369
Lamio	1,774
Biñan	1,719
Mancasar	1,684
Inosema	1,572
Macan Lamio	1,565
Bad-as	1,364
Barangbang	1,200
Manabun-ac	1,051
Macan Santa Rosa	1,045
Piniling Daniel	1,030
Siamese "A"	1,011
Inachupal I	980
Minalabon	1,163

Irrigation experiments: submergence test.—Irrigation experiments carried on during the last three seasons (1923) at Alabang River Station, were directed mainly on the determination of the total amount of irrigation and rain water necessary to mature a normal rice crop. This amount, according to the results, is equivalent to a discharge of water ranging from 1.1 to 1.5 second liters per hectare throughout the submergence period. The experiments were conducted on a flat, closely-diked, old paddy land underlaid with an impervious substratum, and the distribution of water thereon was under perfect control. Initial

flooding was given to raise the water level up to a height of 5 centimeters and the subsequent submergence water had been kept within that height.

The work herein recorded was primarily an attempt at studying the means by which a future method of experimenting may be devised. In a series of six plots various detphs of submergence were tried; that is in Plot No. 1 water was supplied to keep the soil just wet or saturated, as can be possibly done; in Plot No. 2 the submergence depth was marked at 5 centimeters; in Plot No. 3, at 10 centimeters; in Plot No. 4 at 15 centimeters; in Plot No. 5, at 20 centimeters; and in Plot No. 6, the supply was fluctuating.

Each of these plots contained a planting area of one are, 10 meters square, bounded by a single dike, measuring 25 to 30 centimeters wide at the base and 30 to 40 centimeters high. The whole system was connected on the more elevated situation, with the irrigation canal, and a drainage ditch on the opposite side.

Conner rice was planted in the plots August 14, 1923. At that time the seedlings were 50 days old. They were planted in hills containing 3 to 7 plants each, spacing the hills approximately 20 centimeters each way.

The plots were allowed to remain in the mud state until August 21, when a trial submergence in plots 2, 3, 4, 5 and 6 was started. Adjustment of the water was next made and in the afternoon of August 24 the first readings were recorded. Two readings had been taken daily, that is, one at 2. p. m. and the other at 6 a. m. on the next day, the two being considered as pertaining to the first day.

The period over which the submergence had been carried on, extended from August 24, 1923, the date of the first reading to November 4, inclusive or 73 days. At this time the plant was in dough stage, as Conner is an early maturing variety. All surface water was drawn out from every one of the submerged plots. Where water had stood deep as in Plots 3, 4 and 5, the resulting mud-ground was much softer, thinner, like a muck, as compared with other plots submerged to lesser depths, and this fact has given rise to a relative difference in the drying capacity of the plot beds as well as the maturity and lodging of the resulting crops.

The following tables show the depths of water applied, or submergence depths from consolidated morning and afternoon readings, which ran fairly uniform.

Table showing the average of 73 readings for each of the series, or the readings taken throughout the extent of the experiment

Plot Number	2 p. m.	6 a. m.
	Cm.	*Cm.*
1	0.4	0.4
2	5.7	5.7
3	10.6	10.6
4	15.4	15.2
5	20.0	19.2

It is thus seen that with exception of Plot 5 no difference resulted between the 2 o'clock readings and the 6 o'clock readings The lower water height registered for Plot 5 as observed at 6 o'clock was due in a great measure to the difficulty of controlling the water in that plot.

Just about two weeks from the first flooding, September 10, 1923, the young plants were attacked by the rice case worm, *Nymphula depunctalis*. The insect cuts off a good portion of the blades and spends its pupal stage in rolled up portions of the blade. The damage was most severe in Plot 5, where water was flooded 20 centimeters deep, Plot 4 was attacked badly enough though not so severe as Plot 5. In Plots 2 and 3, where submergence water was shallower, the injury by the insect was relatively slight. The condition of Plot 1, kept under moist or thin sheet of water, might well pass as normal. The severity of the insect attack increased for some time and at such a rate that on September 18, all plants in Plot 5 and a good percentage of those in Plot 4, were completely defoliated. Changing the water did not help the situation. The attack was made in the form or an outbreak, and the fact that it was particularly intense on the deeply submerged plots leads one to believe that the activity of the insect was associated with the depth of water.

There was no way of ascertaining the extent of the damage done, consequently the yields of plots given below are not to be considered relative and consistent experimental data. The maximum damage was about 27 per cent, when it is assumed that yield of Plot 1, to be normal or nearly so, and the difference between this yield of Plot 1, and that of Plot 5, which is 370 kilos to the hectare, to be the loss.

Hectare yields were directly computed from actual plot yields.

Plot number	Submergence depth	Yield per hectare
	cm.	*kilos*
1	Just moist.	1,750
2	5	1,100
3	10	1,200
4	15	1,120
5	20	400
6	Fluctuating.	980

Plot 1 which was only moist, was overrun by the common rice weeds, largely by *Eleocharis capitata* and *Cyperus difformis.* It was thus necessary to weed this plot out. A thinner stand of weeds was also evident in Plot 2, 5-centimeter depth of water, and some hand cleaning was given. These weeds, however, were not noticeable in the deeply submerged Plots Nos. 4 and 5, which indicate that deep submergence of 15 to 20 centimeters was effective in controlling that class of weeds.

The deep submergence in Plots 4 and 5 had caused the maturing period to proceed slowly, as a result of the wet conditions of the ground obtaining for over a week after the water was withdrawn from the plots. Plot 1 matured November 15, exactly 179 days counting from the date the seed was set to sprout, whereas Plot 5 matured November 23, or 8 days longer. This relationship was also noticed in other plots. In Plots 4 and 5 the plant fell down to the ground, which was not the case in Plots 1 and 2 and in Plot 6.

Dry season crops—palagad.—The planting was done in February 1923 of six varieties, each occupying an area of about 200 square meters, at Alabang. As in the last two years, Sipot has again occupied the first place in production, with Mangasa and Dinagat taking the second and third places, respectively. The results from Rosales show Sipot also in the lead, then come, Binicol and Sanglay Puti. Saigorot and Lampadan are the two most promising representatives of the bearded class to do well in dry season planting.

The table of yields and the maturing periods follows:

Variety name	Maturing period in days		Yield per hectare in kilos	
	Alabang	Rosales	Alabang	Rosales
Sipot	140	137	2,221	3,094
Mangasa	145	128	1,983	1,400
Dinagat	140	123	1,401	1,095
Binicol	165	....	1,195	1,958
Magsanglay	135	130	1,078	1,431
Lava	140	133	919	1,887

The Kaawa, Inita, and Lampadan, grown in Rosales alone, produced also a very good crop. Possessing an awned grain, the Lampadan variety is looked for to be the most adapted where protection from the birds is a necessity.

It is very probable that Binicol, a popular table rice would do better if planted broadcast so as to remedy its defect of producing uneven stand.

Coöperative Fertilizer Experiments; Experiment No. 1.—The field was planted to "Magasawang palay" on August 16, just after the fertilizers were applied as top dressing and harrowed in lightly. The seedlings at the time of transplanting were 50 days old. The field was only slightly weeded, for the weed growth was thin; irrigated only by rain.

The yields of paddies computed to one hectare, follows:

Plot No.	Fertilizer	Application per hectare		Yield of crop per hectare
		Kilos		*Kilos*
N	Ammonium sulphate	20	N	1,249
P	Acid phosphate	10	P_2O_5	[a]780
K	Potash salt	15	K_2O	[b]908
CaO	Lime	500	Cao	826
Chk	Check			[c]811
NP	Ammonium sulphate	20	N	
	Acid phosphate	10	P_2O_5	1,143
Nk	Ammonium sulphate	20	N	
	Potash salt	15	K_2O	1,005
PK	Acid phosphate	10	P_2O_5	
	Potash salt	15	K_2O	851
NPK	Ammonium sulphate	20	N	
	Acid phosphate	10	P_2O_5	1,143
	Potash salt	15	K_2O	

[a] Yield reduced by disease. [b] Slightly affected by disease. [c] Average yield of four plots.

Increased yields were obtained in all plots which received ammonium sulphate, alone or in combination with other fertilizers. The increase amounted to 324 kilos on average, and was equivalent to 40 per cent of the check crop.

An estimate of the profit which would accrue if ammonium sulphate were to be used on one hectare of rice crop is here submitted.

The market value of 324 kilos or 7.43 cavans of palay gained by fertilization, at ₱4 per cavan		₱29.72
Cost of 100 kilos ammonium sulphate, for 1 Ha	₱9.50	
Freight charges and cost of applying	3.00	
Total expenses		12.50
Gain		17.22

Coöperative Experiment No. 2.—The test was carried in two separate fields at Alabang, herein designated, as Field No. 1 and Field No. 2. Both lands were rated third or fourth class

with respects to productivity, and depend on rainfall for water supply. Field No. 1 was planted August 13, 1923 to Macan rice, the seedlings being about 50 days old. The crop was harvested Decemeber 21. Toward the close of September the plant presented stunted apperance: arrested growth and paling of the leaves' color. Search for insects had failed, and the condition was attributed to physiological disturbance in the soil. The disease appeared in more or less severe form in the two fertilized plots, although during the course of one month or so the plant seemed to have been able to recover normal color and the general condition looked better than the two nonfertilized plots.

Field No. 2 was planted on August 5, with Macan seedlings 41 days old in the seed bed. The crop was cut December 31, 1923.

The fertilizers were spread just before the last harrowing was given preparatory to planting.

The following table shows the results of the nitrogen fertilizers tests:

Fertilizer	Yields per hectare in kilos	
	Field No. 1	Field No. 2
Copra meal	1,231	426
Cattle dung	856	340
Check	748	371

In Field No. 1 copra meal has produced an increase of 483 kilos of palay over the non-fertilized plots. This increase is equal to 64.3 per cent. Cattle dung made, likewise a surplus yield over the check plots, of 108 kilos of palay, equivalent to 14.3 per cent.

In Field No. 2 the gain obtained with copra meal amounted to 55 kilos per hectare, which is equal to 14.8 per cent. In the case of cattle dung, however, the crop obtained fell below that of the check, by 31 kilos, little over 8 per cent.

Thus it follows, that in both tests copra meal made an increased yield, considerable in one, almost insignificant in the other from which no definite conclusion can be drawn.

At least in the first year of experimentation the dung may be supposed to be without effects on the rice crop, according to the results.

Experiment No. 3.—A third year experiment with a fertilizer mixture containing 3.3 per cent nitrogent 11 per cent phosphorous anhydride, and 4 per cent potash, was conducted in Rosales.

Rate of application per hectare	Yield per hectare in kilos		
	1922	1923	Average
100	925	1,902	1,413.5
300	2,346	1,930	2,138.0
500	2,140	1,732	1,936.0

PEDIGREE CULTURE

The first year culture was made of Masiksek rice, a native variety maturing in 195 days and Ryuchu, a well established variety from Formosa, maturing in 133 days and which is remarkable for its erect, non-lodging character.

Several of the pedigreed strains had been propagated. Four new varieties will be submitted to this test.

Drills versus broadcast planting.—This was a test on the efficiency of the two methods of planting upland rice—drill method and broadcasting. The seed used was Kinampupoy.

On one lot of ready ground, the seed was sown broadcast, and then plowed and harrowed in. On another lot of the same field it was drilled in rows 15 centimeters apart with a "Van Brunt" grain planter.

The yields per hectare are:

Drilled	1,137
Broadcasted	744

Hot-water seed treatment.—The hot-water (or Jensen) treatment on rice seed attacked with a fungus was tried. The seed used was that of Kathisod, a glutinous rice from Siam. Treated seed showed fungus growth during germination test, so was the crop grown from that seed.

Seed propagation.—The bulk of the propagation crop in Rosales was destroyed by the flood. At Alabang the yields had been much reduced by the unfavorable weather, characterized by drought followed by heavy rains.

Some 200 cavans of lowland rice seeds would be produced from both stations.

UPLAND RICE

The experiments on upland rice were performed at the Lamao Experiment Station. They were experiments devoted to finding superior varieties and to improving the most worthy of these by pedigree or line selection.

One hundred thirty-four upland varieties were planted in the regular test. Unfortunately, though, the floods which swept the station on November 18–19, 1923 had carried away the crops just before they could be harvested.

Of the pedigree culture all that was wanted for the continuation of the work, could be saved.

In the La Carlota Experiment Station at La Carlota, Occidental Negros over 36 hectares of land were planted to upland rice, and the crop is being disposed off largely as feed for the station stock, and the small better portion as seed for coöperators' planting.

CORN

LAMAO EXPERIMENT STATION

Variety test yields in dry season planting

Variety name	Computed yield per hectare		Shelling percentage
	Ears in kilos	Grains in cavan	
Moro	2,903.24	35.49	76.42
Calamba	3,534.28	46.44	82.14
Bohol	3,267.12	42.02	80.40
Cebu	3,250.49	41.86	80.27
Calipus	3,229.35	41.59	80.50
Kalaylay	2,327.08	29.82	80.08
Ferguson Yellow	2,188.93	25.56	82.14
Ferguson White	2,840.74	38.11	83.85
Cagayan	2,046.75	27.28	82.35
Check (Moro)	2,843.75	34.77	76.42

Planted, October 24–26, 1922.
Harvested, February 5–11, 1923.
Area of unit plots, 432 square meters.

Variety test yields in wet season planting

Variety name	Computed yield per hectare		Shelling percentage
	Ears in kilos	Grains in cavan	
Moro	696.76	7.27	65.18
Cagayan	733.80	7.78	66.31
Kalaylay	856.48	9.72	70.97
Lobo	738.42	4.75	66.46
Ferguson White	446.92	4.45	62.88
Ferguson Yellow	296.29	3.00	69.72
Check IV (Moro)	692.12	7.11	64.26
Baluga	733.80	8.42	69.00
Calipus	798.84	7.38	57.75
Calamba	1,013.88	11.70	72.16
Bohol	905.09	10.44	72.16
Cebu	592.59	6.08	64.18
Check (Moro)	692.12	7.11	64.26

Planted, May 24, 1923.
Harvested, September 10–12, 1923.
Area of unit plots, 432 square meters.

Speaking generally, the growth during the dry season was vigorous, of even stand, and producing ears of large size. Calamba Yellow, Bohol, Cebu, and Calipus were the best yielders. The last two named varieties produced practically the same yields.

Poor yields were obtained from the wet season crop because the first planting, made on May 16, 1923, was attacked by locust,

and the second one herein reported was greatly damaged by the rains. Many of the plants produced no ears at all.

The Calamba, Bohol, and Kalaylay gave good yields. They had, together with the Ferguson varieties, given high proportions of shelled corn.

To check the results obtained from the dry season planting of 1922, a similar planting was done last October, but the experiment was destroyed by the flood, occasioning the loss of seven varieties.

Distance of planting test.—The experiment has been carried on in conjunction with the variety test during one rainy season and one dry season.

Yields in dry season planting

Variety name	Computed yield per hectare in kilos			
	1 × .70 m.	1 × .80 m.	1 × .90 m.	1 × 1 m.
Moro	3,250.00	2,851.85	3,194.44	2,879.63
Calamba	4,185.18	3,842.59	3,388.88	3,157.40
Bohol	3,333.33	3,148.14	3,504.63	3,393.51
Cebu	3,074.07	3,305.55	3,250.00	2,379.62
Calipus	3,444.44	3,430.55	3,212.96	3,018.51
Ferguson Yellow	2,175.92	2,259.25	2,148.14	2,231.48
Ferguson White	3,453.70	3,305.65	2,509.25	2,018.51
Cagayan	1,759.26	2,111.11	1,907.40	1,777.77
Check (Moro)	3,275.00	2,782.40	2,761.11	2,555.55
Kalaylay	1,490.74	1,972.22	2,083.33	3,518.51

Yields in wet season planting

Variety name	Computed yield per hectare in kilos			
	1 × .70 m.	1 × .80 m.	1 × .90 m.	1 × 1 m.
Check I (Moro)	481.48	407.40	731.48	500.00
Moro	351.85	400.74	601.85	542.59
Cagayan	611.11	527.77	805.55	638.88
Kalaylay	685.18	759.25	944.44	833.33
Check II (Moro)	462.96	722.22	861.11	666.66
Lobo	712.96	790.74	842.59	546.29
Ferguson White	500.00	546.29	574.07	500.00
Ferguson Yellow	462.96	361.11	416.66	462.96
Check III (Moro)	1,009.25	601.85	1,037.03	824.07
Check IV (Moro)	685.18	759.25	935.18	435.18
Baluga	712.96	638.88	861.11	564.81
Calipus	555.55	712.96	692.96	573.98
Check V (Moro)	731.48	812.96	879.62	712.96
Calamba	1,101.85	777.77	1,166.66	712.96
Bohol	777.77	861.11	1,000.00	953.70
Cebu	675.92	657.41	777.77	500.00
Check VI (Moro)	777.77	666.66	1,083.33	759.25

Poor yields were obtained from the wet season test as the culture suffered from excessive rains and high winds throughout the growing period. Rats and wild hogs had also shared in the destruction.

With four out of nine varieties under the dry season planting, the yields increased with the decrease of space; four were indifferent with spacing; and one yielded in direct ratio to spacing.

Of the varieties planted for the wet season test, the best results were obtained from the 1 meter by .90 meter spacing. This distance gives ample space for the corn plants to properly develop, and allows room for cultivation.

Manifestly, if the crop is to be disposed of as animals' feeds, then close spacing of, say 1 meter by .70 meter should be adapted. For grain production, 1 by .90 meters would be preferable.

Another series of experiment was started with Calamba yellow corn in accordance with the following scale:

Distance	Plants per hill
1 m. × 30 cm.	1
1 m. × 50 cm.	1
1 m. × 70 cm.	2
1 m. × 90 cm.	2

The work is in progress.

Fertilizer test.—The test was confined to 6 plots only, each having an area of 264 square meters. Cagayan corn was planted in July, 1923.

The following table gives the kinds of fertilizer used, estimated cost of same, rates of application and results obtained, from the experiment.

Plot No.	Fertilizer	Composition	Rate of application per hectare in kilos	Estimated cost fertilizer per hectare	Cost of production per hectare	Estimated yield per hectare in kilos
1	Check	None	None		₱72.72	91.66
2	Ammonium sulfate Sulfate of potash Acid phosphate	N–3% K–1½% P–7%	150	₱20.83	97.74	94.69
3	do	do	600	31.81	116.02	93.93
4	do	do	1,050	146.59	223.48	140.15
5	Mixture	N–3% K–10% P–4%	400	131.81	206.38	100.00
6	Cattle dung	N–0.5	10,000	....	80.29	197.00

Very poor results were obtained from this test because the culture was badly affected by rains. Much of the fertilizers was washed out. At tasseling, the plants were attacked by corn borers; and no ears were found in most of them.

Propagation.—The object is to propagate in a more or less extensive way the best varieties of corn for distribution to the farmers.

Below is a detailed account of the work.

Culture No.	Variety	Area planted in square meter	Cost of planting per hectare	Yield per hectare in kilos	Number of days to maturity
1	Calamba	860	97.21	910.46	94
2	Moro	3,200	58.75	315.31	91
3	Cagayan	3,000	59.33	619.33	87
4	Moro	6,230	80.00	1,436.33	87

Cultures Nos. 1, 3, and 4 were planted on caingin land. High initial cost of operations was occasioned by the clearing and difficulty encountered in planting the field.

SUGAR CANE

LA CARLOTA EXPERIMENT STATION

Variety test—plant cane.—There were grown in this test 16 varieties of sugar cane, including the Negros Purple, which was used as check. Each variety occupied 4 rows 150 meters long, the distance between the rows being 1.20 meters. The spacing between the plots was also 1.20 meters.

Planting was made December 8–15, 1922. A block measuring 66.7 square meters was harvested November 8–15, 1923 from each plot. Sample canes were submitted for analysis. The results are given in the table below.

Production in sugar and tonnage computed to one-hectare basis

Variety name	Yield of cane per hectare in tons	Yield of sugar per hectare in piculs	Tons of cane per ton of sugar	Piculs of sugar per ton of cane
Yellow Caledonia	....	....	8.84	1.79
New Guinea 24-B	87.604	....	6.23	2.54
Malabar	75.259	107.62	11.08	1.43
Louisiana striped	58.388	140.13	6.60	2.40
Java 247	....	....	8.25	1.92
Goru or New Guinea-24	88.110	183.26	7.61	2.08
Barbados	85.260	....	6.51	2.43
New Guinea 24-A	....	....	6.66	2.36
Rose bamboo	43.357	104.49	6.57	2.41
Luzon-1	62.795	156.98	6.33	2.50
Luzon-2	68.582	149.48	7.26	2.18
Luzon-3	60.687	118.94	8.08	1.96
Luzon-4	89.385	146.59	9.65	1.64
Big Tanna 3525	72.678	106.10	10.84	1.46
Badila	95.913	149.37	6.09	2.60
Negros Purple	75.915	113.59	7.94	2.04

Description of stools

Variety name	Number of stalks per stool	Length of stalks in meters	Average weight per stalk in kilos
Yellow Caledonia	3	2.05	2.25
New Guinea 2 4-B	3	1.83	1.36
Malabar	4	1.89	2.14
Louisiana Striped	4	1.88	1.71
Java 247	5	1.91	1.23
Guro or New Guinea-24	3	1.70	1.33
Barbados	2	1.71	1.22
New Guinea 24-A	3	2.05	1.31
Rose bamboo	3	1.73	.90
Luzon-1	4	1.45	1.03
Luzon-2	4	1.63	1.15
Luzon-3	5	1.68	1.03
Luzon-4	5	1.81	1.56
Big Tanna 3525	3	1.89	1.94
Badila	4	1.62	1.33
Negros Purple	4	1.47	.93

Analysis of the canes, 11 months old

Variety name	Juice				Bagasse		Cane	
	Corrected brix	Sucrose	Approx. purity	Acidity n/10	Sucrose	Fiber	Sucrose	Fiber
		P. ct.			P. ct.	P. ct.	P. ct.	P. ct.
Yellow Caledonia	16.40	13.37	80.9	2.3	5.83	39	10.62	14.23
New Guinea 24-B	18.50	16.53	89.3	1.1	8.70	37	14.30	12.60
Malabar	15.33	11.61	75.8	3.3	3.74	31	8.64	11.76
Louisiana striped	17.10	15.56	91.7	2.4	5.51	33	12.25	10.82
Java-247	16.50	13.71	83.9	1.5	7.02	37	11.51	12.00
Goru	17.23	14.63	84.9	1.7	7.11	37	12.18	11.98
Barbados	18.33	16.28	89.0	1.4	8.12	39	13.48	13.33
New Guinea 24-A	17.63	15.71	89.1	1.4	8.63	37	12.99	13.98
Rose bamboo	17.70	15.90	89.9	1.6	5.47	35	12.15	12.67
Luzon-1	18.00	16.32	91.0	1.5	8.22	35	13.42	12.42
Luzon-2	16.81	14.73	88.0	1.3	8.42	35	10.40	12.69
Luzon-3	15.67	13.53	86.5	1.0	8.76	35	11.70	13.30
Luzon-4	13.87	11.61	84.1	1.2	8.37	37	10.70	10.88
Big Tanna 3525	15.67	11.88	76.1	2.3	6.43	42	10.20	12.69
Badila	19.47	17.35	89.0	1.6	11.07	37	15.99	7.95
Negros Purple	14.31	14.10	86.3	1.4	8.41	33	12.16	11.17

NOTE: The percentage extraction by hand mill ranges from 61.8 (New Guinea 24-a) to 78.5 (Badila). The average for Negros Purple is 66.5.

Java 247, Yellow Caledonia, New Guinea 24–A, Guro (New Guinea–24) and Badila gave very high tonnage yields. New Guinea 24–A, New Guinea 24–B, Barbados and Java 247 gave high sugar production. The results on commercial basis will be submitted in due time.

Variety test—first year ratoon.—Of the 16 varieties ratooned, the Goru ranked first among the first year ratoon crops, Yellow Caledonia second, and Java 247, third. In sugar production, however, Barbados leads the list, with Java 247, Yellow Caledonia, and Luzon 2 coming in order.

The crops were ratooned January 9, and the canes were harvested November 9–15, 1923.

The yields in the following table are computed from 15-square meter plots.

Production in tonnage and sugar computed to one-hectare

Variety name	Yield of cane per hectare in tones	Yield of sugar per hectare in piculs	Tons of cane per ton of sugar	Piculs of sugar per ton of cane
Badila	38.42	91.82	6.62	2.39
Barbados	68.36	....	3.44	2.91
Big Tanna 3525	68.42	101.26	10.70	1.48
Goru	84.57	122.62	10.92	1.45
Java 247	73.28	161.95	7.16	2.21
Luzon-1	55.28	140.41	6.23	2.54
Luzon-2	65.37	143.59	7.23	2.19
Luzon-3	49.50	123.25	6.36	2.49
Luzon-4	46.28	108.29	6.77	2.34
Malabar	68.35	112.09	9.65	1.64
Negros Purple	50.28	120.67	6.60	2.40
New Guinea 24-A	43.00	88.15	7.72	2.05
New Guinea 24-B	47.28	99.76	7.50	2.11
Rose bamboo	45.28	104.59	6.85	2.31
Yellow Caledonia	80.70	157.38	8.12	1.95
Louisiana striped	57.71	115.97	7.88	2.01

Description of stools

Variety name	Number of stalks per stool	Length of stools in meters	Weight per stalk in kilos
Badila	4	1.30	1.05
Barbados	4	1.40	1.33
Big Tanna 3525	4	1.52	1.95
Goru	4	1.51	1.47
Java 247	6	1.29	.95
Luzon-1	4	.93	.82
Luzon-2	3	1.00	.93
Luzon-3	5	1.17	.77
Luzon-4	5	1.14	.72
Malabar	4	1.39	1.33
Negros Purple	5	1.16	.78
New Guinea 24-A	6	1.76	1.04
New Guinea 24-B	4	1.12	1.38
Rose bamboo	6	1.14	.71
Yellow Caledonia	4	1.62	1.98
Louisiana striped	4	1.41	1.16

Analysis of canes, 10 months old

Variety name	Juice				Bagasse		Cane	
	Corrected brix	Sucrose	Aprox. purity	Acidity n/10	Sucrose	Fiber	Sucrose	Fiber
		P. ct.			P. ct.	P. ct.	P. ct.	P. ct.
Badila	18.5	16.21	87.6	2.1	7.62	26.5	13.29	10.81
Barbados	15.6	14.64	93.8	3.6	6.13	19.0	11.45	14.58
Big Tanna 3525	15.0	11.66	77.7	3.7	5.93	35.5	9.53	13.10
Goru	18.5	13.14	71.0	2.9	6.30	37.0	10.70	13.70
Java 247	17.4	15.17	87.1	3.1	6.16	36.0	11.52	14.50
Luzon-1	18.1	16.56	91.4	2.4	9.38	35.0	13.15	11.69
Luzon-2	16.43	14.64	89.1	2.0	7.70	34.6	12.32	12.60
Luzon-3	17.13	15.90	92.8	1.7	7.09	32.5	12.48	12.60
Luzon-4	16.47	15.15	91.9	1.6	9.98	39.0	13.27	14.15
Malabar	15.90	12.59	79.2	5.0	7.10	31.3	10.24	13.30
Negros Purple	17.57	15.87	90.3	2.8	10.12	38.3	13.78	13.80
New Guinea 24-A	15.93	13.98	87.7	2.4	7.79	36.0	11.49	14.40
New Guinea 24-B	17.17	14.73	85.7	3.2	6.89	37.0	11.81	13.78
Rose bamboo	16.93	15.27	90.1	2.8	8.20	35.0	12.89	11.86
Yellow Caledonia	16.03	13.69	85.4	4.9	6.11	39.0	10.67	15.52
Louisiana striped	16.00	13.88	86.7	1.8	8.15	34.3	11.59	7.61

NOTE.—The percentage of extraction by hand mill ranges from 57.5 (New Guinea 24-A) to 77.8 (Louisiana Striped).
Results in commercial basis to be submitted later.

Fertilizer experiment.—Negros Purple cane was planted in the first week of December, 1923, in two series of plots. Hills were distanced one meter apart from row to row and 40 centimeters in the rows. Plots measured 50 meters long and 10 meters wide each and were separated by strips 1.5 meters wide.

Fertilizers were applied on May 9, 1923, approximately 5 months from the date the cane was planted. The following table shows the kinds and compositions of the fertilizers and rates of applications used. The figures on tonnage and sugar yields being of sample cuttings only do not represent the final yields, which will be submitted after the crops of the entire canes have been milled.

Kind of fertilizer	Composition %N	Composition $\%P_2O_5$	Composition $\%K_2O$	Rate of application per hectare	Average yield of cane per hectare in tons	Average yield of sugar per hectare in piculs	Succrose in cane. Average analysis
							Per cent
Ammonium sulphate	20	......	......	200	109.9	147.7	9.64
Treble superphosphate	......	47	......	520	....	....	12.49
Potassium sulphate	......	......	20	150	166.5	170.2	11.81
Lime	......	......	......	500	105.8	183.5	10.54
Ammonium sulphate Treble superphosphate	20	47	......	720	....	....	12.58
Ammonium sulphate Potassium sulphate	20	......	20	350	162.0	143.6	10.24
Potassium sulphate Treble superphosphate	....	47	20	670	95.0	....	11.09
Ammonium sulphate Potassium sulphate Treble superphosphate	20	47	20	870	97.2	150.2	9.72
Ammonium sulphate Potassium sulphate Treble superphosphate Lime	20	47	20	1,370	87.0	125.3	9.40
Control	......	......	......	....	90.0	....	12.40

Distance of planting test.—The results so far were not so marked with respect to yields as those of last year's experiment, but it was again evident that close spacing, 80 centimeters by 10 centimeters, for instance, gives a higher net production of cane and sugar than the open planting, 1.20 centimeters by 40 centimeters; and this relation appears to be fairly well kept up for every graduation of spacing.

The ability of Badila plant to maintain an erect position, as compared to Negros Purple, is a distinct advantage from agronomic view point.

Mosaic disease experiment.—The mosaic and non-mosaic Negros Purple cuttings were planted on December 28, 1922. On February 26, 1923, hills were examined for the number of dead and number of living hills. Another counting was made on October 31, 1923.

Number of mosaic and healthy hills and death rates

Plot No.	February counting—numbers						October counting—numbers					
	Mosaic			Healthy			Mosaic			Healthy		
	Living hills	Dead hills	Death rate	Living hills	Dead hills	Death rate	Living hills	Dead hills	Death rate	Living hills	Dead hills	Death rate
			P. ct.			P. ct.			P. ct.			P. ct.
1	688	352		......	......		642	46		......	......	
2	......	......		744	296		......	......		702	42	
3	514	526	41.9	......	......	36.6	514	0	3.9	......	......	3.2
4	......	......		664	376		......	......		642	22	
5	611	429		......	......		586	25		......	......	
6	......	......		569	471		......	......		569	0	
Total	1,813	1,307	41.9	1,977	1,143	36.6	1,742	71	3.9	1,913	64	3.2

The following tables give the average measurements taken with the cane stools of the mosaic and healthy plants, the percentage of sugar contained in the cane, etc.

Plot No.	Seed cane	Number of stalks per stool	Weight per stalks	Length of stalks	Diameter of stalks
			Kilos	Meter	Cm.
1, 3, 5	Mosaic	3.6	1.26	1.18	7.9
2, 4, 6	Healthy	5.4	1.30	1.31	8.3

Analysis

Plot No.	Seed cane	Succrose in cane	Tons of cane per ton of sugar	Piculs of sugar per ton of cane
		Per cent		
1, 3, 5	Mosaic	12.91	7.17	2.21
2, 4, 6	Healthy	13.65	6.54	2.42

Acclimatization test.—Several new varieties were introduced in Lamao. The more promising varieties and strains are the H–109 seedling, Barbados Striped, New Guinea–40 sport, H–27 seedling, Inalmon No. 2–Pl, Inalmon No. 1–Pl, Malagache and Tapol. The "C. A. C" strains from the College of Agriculture, University of the Philippines, are adapted to local conditions.

Experiment on large versus small sized points.—The experiment involved the planting of 25,000 points (Negros Purple) with the aim to find out if there was any advantage to be gained in selecting large-sized points with well developed "eyes" for planting. Accordingly, the points were sorted and grouped into large-sized points and small-sized points. A third lot was made up of mixed sizes.

The crop was still in the field when the report was being written, yet to judge from the results of measurements there would be little or no difference since the selection was not based on individuality of plants.

[Average figures]

Points	Number of stalks per stool	Height of stalks	Diameter of stalks	Length of internode
		Meter	Cm.	Cm.
Big sized	7	1.16	2.60	8.15
Small sized	7	1.15	2.58	8.09
Mixed sizes	7	1.20	2.58	8.09

Seedling cane production.—Larger collection of seeds has been obtained this year, from a number of leading varieties of sugar cane at La Carlota and Alabang.

At La Carlota the Inalmon and Hawaii 109 seedling canes, which were grown from seed in 1921 are still under observation. Of the 1922 stock, there have been just recently planted in the nursery two selected stools of Java 247 and one stool of Formosa variety. The seedling plants of Otomato did not survive at La Carlota. Inferior individuals have been discarded. In Alabang Rice Station ratoon plants of Badila seedlings were allowed to grow. One of these has produced a large number of fine stalks. Cuttings of same have been set out in the field.

Growing of sugar cane for seed—costs of production.—The La Carlota Experiment Station has made an estimate of the expenses incurred in connection with the raising of sugar cane on 4 hectares, and gives the cost of production per hectare as follows:

Items	Expenses
Preparation of land	₱120.00
Planting (including value of seed cane)	52.00
Cultivating	130.00
Harvesting and hauling	138.00
Total	440.00

TOBACCO

DAMMAO TOBACCO STATION

The activities of the Dammao Tobacco Station at Gamu, Isabela during the year have been principally the further testing of promising native varieties and strains and the acclimatization of equally or more promising foreign varieties. The former were on the whole, bred for high yield and the latter for wrapper suitability. Two hectares were employed for the tests. It is expected that barring adverse conditions during the tobacco season, at least 30 fardos of wrappers, 30 fardos of binders, and 140 fardos of fillers will be raised incidentally from all the experimental cultures.

Seed beds.—Because originally it was intended to supply pedigreed seedlings to all the coöperators of the station, 2 hectares of seed beds were prepared and sown but these were destroyed only by the record November flood. However, the other seeds in stock were sown immediately on seed beds covering an area of one hectare. The good germination of these insured a suffi-

cient supply of seedlings for the cultures during the ensuing tobacco season, for which at least 40,000 seedlings will be required.

Vitality tests of seeds.—This experiment was incidentally carried out in connection with the open beds and the germinating boxes of all the seeds of the different varieties and strains used in the variety and propagation tests conducted by the station. Three important points were observed. First, under the same conditions, different varieties and strains of tobacco exhibit different degrees of viability, ranging from 65 per cent to 95 per cent for fresh seeds and from 10 per cent to 50 per cent for one-year old seeds. Vigorous strains of 11 Espada Dammao and 12 Dammao Broadleaf showed as high a germination as 80 per cent when the seeds are stored in well-sealed paper packages kept in Mason fruit jars. Experience with these jars shows though that the viability of seeds stored in them falls after one year, to about 50 per cent. Second: A very high germination percentage is obtained under controlled conditions as in the case of germinating boxes which could be kept safely in a shed. Irregularity in weather conditions in the Cagayan Valley is responsible for irregular germination percentages for the same strain or variety in different seasons. Third: Provided germination is well controlled, ten mother plants can easily supply seedlings to plant two hectares of tobacco land. In this year's seed beds an individual plant of 18 Florida Sumatra produced at least 3,000 fine healthy seedlings.

Acclimatization tests.—The foreign varieties 18-Florida Sumatra, 358-Sumatra, 1-Connecticut Havana, 28-Havana, 25-Dumbara and 36-Bahis were used. Of these varieties only the 18-Florida Sumatra showed normal performance although rather markedly susceptible to mosaic.

General variety test.—In addition to the six foreign varieties already referred to, ten native varieties were used in this experiment namely, 34-Anipa Sumatra, 53-Dammao Medium Hybrid (three types), 12-Dammao Broadleaf, 14-Dammao Medium Broadleaf, 11-Dammao Espada, 4-Palattao Broadleaf, 49-Cauayan, 10-Dammao Medium Repollo, 6-Anipa Broadleaf, and 51-Angadanan.

Four noteworthy points were observed in this experiment. First: The native variety as a whole showed the best vegetative performance whereas the foreign varieties with the exception of the 18-Florida Sumatra, were deficient in some way or other. Second: 12-Dammao Broadleaf showed the greatest number of standard leaves (26 as well as by a very high breadth index

[47 per cent] for a typical filler strain) Third: 11-Dammao Espada proved itself to be the most prolific grower but unfortunately possessed the lowest breadth index (39 per cent). Fourth: 6-Anipa Broadleaf showed itself to be a great possibility by surpassing by 1 per cent the breadth index of 12-Dammao Broadleaf although it had 3 less leaves.

Effect of spacing on planting.—The varieties 18-Florida Sumatra, 12-Dammao Broadleaf, 14-Dammao Medium Broadleaf, 54-Anipa Sumatra and 58-Dammao Medium Hybrid No. 1 were used in this experiment. Two distances were employed.

(*a*) 70 by 70 centimeters.
(*b*) 50 by 80 centimeters.

No favorable results were obtained in this experiment owing to the May showers which washed away the gum from the leaves and which incidentally made the leaves susceptible to all kinds of leaf spot diseases. A noticeable change in texture was, however, observed which warrants the repetition of this experiment.

Wrapper variety tests.—In this experiment, the varieties 53-Dammao Medium Hybrid No. 1, 54-Anipa Sumatra, 14-Dammao Medium Broadleaf, 11-Dammao Espada, 12-Dammao Broadleaf, 4-Palattao, 17-Pampano, 10-Medium Repollo, 49-Cauayan, 50-Echague and 1-Connecticut Havana were used. Shade was provided by a partially cleared young forest and by alternate rows of corn. In the first case the plants were set out 50 by 50 centimeters apart and in the second, 50 by 80 centimeters. The first method was quite successful especially in the case of the native 4-Pallattao. The second method was a failure as the plants were very much affected by mosaic.

Curing experiment.—This experiment was conducted in order to compare the Modified Native Method with certain foreign approved methods; namely, (1) Face-to-face and back-to-back, (2) Face-to-back, and (3) Cuban in which the leaves are pierced with twine so that they ride alternately on the poles. The controls were the native methods of (1) partially curing the leaves in the sun and afterwards hanging them up in the curing shed and (2) partial sun-drying and afterwards hanging them under the house.

Observations made during the experiment showed that all the methods tried with the exception of the two alternative native methods, were satisfactory. With the Cuban method the leaves are cured one day earlier but this difference is immaterial. The

method followed at the station is a sort of the modified native method. The leaves are strung side by side, folded in palillos capable of holding at least 50 leaves and allowing a finger-breadth between the leaves. The leaves are racked directly into the shed for complete shade and slow curing. This method showed as favorable results as the approved foreign method.

Preliminary histological studies.—These studies were incidentally started in an attempt to account for the so-called "quality" of wrapper leaves. The relatively well-developed cuticle of the Sumatra seems to be responsible for its ability to stand the stress to which it is subjected to in spite of its thinness which amounts almost to transparence. On the other hand its central parenchymatous cells appear to be very weak as they (cells) cannot be well defined when the leaf is cured and fermented. Curiously enough, these facts are reversed in the native Dammao Medium Broadleaf; that is, the latter has a relatively poor cuticle but a stronger central parenchyma.

Seed and seedling distribution.—There were distributed in all 19,470 seedlings representing seven different varieties and 51.62 kilos of seed of ten varieties.

PIKIT TOBACCO STATION

The work of the Pikit Tobacco Station has been in the main, the continued planting of the wrapper varieties, and the experiments for the acclimatization and improvement of same. The hectarage devoted to the crop increased from two hectares in the 1922–1923 season to 3 hectares during the ensuing season. The present crop, if conditions remain normal, may be expected to be about 1,000 kilos of wrapper tobacco and twice that quantity of binder and filler leaves.

Seed-beds.—Two nurseries were prepared. There were 94 seed-beds of moderate size. Over 100,000 seedlings were raised, pricked and distributed. Sowing was done in October.

Experiment on the intensive and extensive methods of planting.—The extra amount of care and consequent outlay per unit area with the modern way of planting is greater than in the case of the native method, but, it has been observed that there is a greater development and more uniform stand of the plants than by the former method, that may more than compensate for the extra work and expense. The experiment is being tried in four plots having 1,000 square meters each. The Florida Sumatra tobacco was used.

Seasonal planting.—Seasonal plantings at Pikit have been carried on through 2 sets of experiments; that is, the first set was planted in the months of April and May, for off season crops, and the second set was planted in September and October for regular season crops. In the first set the variety used was Baker Sumatra. The area planted was limited. In the second set, however, several varieties, all of the wrapper class, have been used. The September planting included the Baker's Sumatra, the two newly received S. P. No. 1 and S. P. No. 2, and Florida Sumatra; while the October planting has comprised all these varieties plus some hybrids. Greater hectarage has been employed with the two regular season plantings. The crops planted in April for trial during the off season was a failure on account of the seedlings have been attacked by insect borers during the seedling stage.

Better results were secured with the crop planted in May. While the growth was uneven as a result of different ages of seedlings transplanted. The production was large, and the percentage of wrapper was correspondingly so. The sowing of this crop was done on May 19 and the seedlings were transplanted beginning July 16, 1923. Harvest was begun on September 6th and continued up to October 20th. The leaves were classified into two groups; the wrapper class, and binder-filler class. The quantity of these 2 classes follows:

Variety	Area planted	Production		Per cent wrapper	Production per hectare		
		Wrappers	Binder and filler		Wrappers	Binders	Total
	Sq. m	*Kilos*	*Kilos*	*Per cent*	*Kilos*	*Kilos*	*Kilos*
Baker's Sumatra	100	6.2	7.8	44.2	618.8	781.2	1,400

The results indicate that the raising of the off season crops planted in May is more or less profitable. With regard to the regular season planting the first sowing was done in September and the second sowing in October. The crop planted in September has been considerably delayed in transplanting, and thus gave rise to the poor stand of the Florida Sumatra variety. However, this delay did not affect in anyway the Baker's Sumatra and the two S. P. varieties, all of which showed good growths. The harvest of these crops have been made in December.

Plant-to-the-row tests with hybrid plants.—Approximately 2,000 square meters of ground have been planted to several selections of the following hybrids.

Field No.	Parent plants	Station name	Row Nos.
A	Sumatra X Florida Sumatra	....	1–20
B	Florida Sumatra X Sumatra	....	21–40
C	Dammao Broadleaf X Sumatra	"Dammatra"	41–50
D	Connecticut X Sumatra	"Connatra"	51–56
E	Havana X Sumatra	"Havanatra"	67–77

A test on distances of planting for these hybrids is underway. There are grown separate plots of B X hybrids. Hybrids show diversity of growth, vigor and character. Florida Sumatra hybrids show distinct improvement in the texture of leaves over the parent plants.

Tephrosia candida is being tried by the station as shade plant for tobacco. It was planted at the end of June in rows running North and South, and set 4½ meters apart. In the middle of November, four to five months afterwards, four rows of Florida Sumatra were planted in between the rows of *Tephrosia candida,* at a distance of 90 centimeters from one another; also five rows each of Baker's Sumatra, S. P. No. 1, S. P. No. 2, and B X Hybrid, at a distance of 80 centimeters from one another. The total area covered by this experiment is 7,830 square meters.

Variety and acclimatization tests.—Inasmuch as filler varieties, or at least most of them, do well in the Cotabato Valley there is no need of further experimenting with them. The station was specially interested in the wrapper varieties and has therefore set out Baker's Sumatra, S. P. No. 1, S. P. No. 2, and Florida Sumatra, in connection with the variety test.

S. P. No. 1 and S. P. No. 2 are new varieties of the Sumatra class. S. P. No. 1 resembles Baker's Sumatra in form and general appearance. S. P. No. 2 has wider and greener leaves than No. 1. Culture of the latter variety under the seasonal planting experiment indicates that it is quite susceptible to chlorosis.

The two new varieties and Sumatra American grown, Bohia, and 199 Hybrid Montgomery are growing in the acclimatization test plot.

Distances of planting with wrapper varieties.—Distances have been arranged to conform to plant types. Thus with Baker Sumatra, which is small leafed type the distances are:

90 centimeters by 50 centimeters.
90 centimeters by 40 centimeters.
80 centimeters by 40 centimeters.
50 centimeters by 50 centimeters.

With the broad-leafed Florida Sumatra wider spaces are provided:

100 centimeters by 50 centimeters.
100 centimeters by 40 centimeters.
80 centimeters by 50 centimeters.
90 centimeters by 40 centimeters.

FORAGE CROPS

Lamao Experiment Station.—Comparative test.

The following table gives the number of cuttings and aggregate yields obtained from each species.

Name of grass	Computed yield per hectare in kilos
Check I (Guinea)	240,894
Napier	313,037
Guinea	184,439
Guatemala	143,746
Cayenne	32,265
Check II (Guinea)	110,405
Paspalum dilatatum	111,998
Para	112,413
Bugalon	28,720
Check III (Guinea)	111,080

Distance of planting test.—The distance of planting between the rows was 1 meter; the distance between the hills in the rows varied in this test, from 25 centimeters to 40, 55, 70, and 85 centimeters for each crop.

The following table shows the aggregate yields from cuttings made every 40 days.

Name of grass	Computed yields per hectare in kilos				
	1 × .25	1 × .40	1 × .55	1 × .70	1 × .85
Check I (Guinea)	8,660.00	7,885.71	7,240.00	6,720.00	5,597.14
Napier	15,515.15	13,851.51	11,000.00	10,848.48	10,336.66
Guinea	6,893.65	6,308.00	6,090.00	6,088.88	5,092.06
Guatemala	6,900.00	6,314.28	5,385.71	4,980.00	4,185.71
Cayenne	621.43	521.42	435.71	414.28	300.00
Check II (Guinea)	3,898.18	3,918.09	3,316.36	3,403.63	2,909.02
Paspalum dilatatum	4,181.25	3,618.75	3,600.06	3,100.00	3,106.25
Para	3,073.32	2,706.66	2,720.00	2,360.00	2,253.33
Bugalon	446.66	446.66	413.33	413.33	353.33
Check III (Guinea)	3,308.00	3,098.41	2,768.25	2,679.52	2,482.53

The yields increase as distances between the plants decrease. Best results were produced by the distance of 25 centimeters and 40 centimeters in the row.

New introduction.—This work has for its object the propagation of introduced plants found adapted to Philippine conditions.

The following table shows a list of the new forage plants and record of trials.

Name of plant	Source	Area planted	Date planted	Germination test	Adaptability	Remarks
		Sq. m.		*Per cent*		
Australian blue grass. .	Hawaii. . . .	2.00	8-5-23	0	. . . .	Plants died.
Wonder forage.	Hawaii. . . .	20.00	5-10-23	40	Fair. . . .	Included in forage yield test.
Pennisetum setosum. . . .	. . . .do. . . .	20.00	5-10-23	45	. . .do. . . .	
Zacate blanca de Honduras.	Cuba.	20.00	5-10-23	87	. . .do. . . .	
Exphorus unisetus.	Hawaii. . . .	3.00	8- 5-23	60	Poor. . . .	Carried by flood.
Pennisetum complanatum.	Hawai.	2.00	8- 5-23	0	. . . .	
Juda.	. . . . .do. . . .	.90	8- 5-23	0	. . . .	
Fussy top.	. . . . .do. . . .	2.00	8- 5-23	0	. . . .	
Bayakibok.	Santa Cruz, Laguna.	100.00	8-18-23	70	Promising	Growing luxuriantly in paddy soil.
Merket.	. . . .	130.00	8- 5-23	95	Good. . . .	Growth, same as Napier.
Pennisetum longistalum. . .	. . . .	. . . .	. . . .	. . . .	Died. . . .	Plant received in dried condition.
Panicum antidotali. . . .	. . . .	2.00	8- 5-23	0	. . . .	

Yield and Feeding Tests of Grasses.—The following table shows the yields per cutting on one hectare basis.

Name of grass	Yields of grass when cut at—							
	20 days old	30 days old	40 days old	45 days old	50 days old	60 days old	75 days old	90 days old
	Yield (kilos)	Yield (kilos)	Yield (kilos)	Yield (kilos)	Yield (kilos)	Yield (kilos)	Yield (kilos)	Yield (kilos)
Check (Guinea).	39,121	63,713	36,260	. . . .	33,180	68,420	. . . .	. . . .
Napier.	64,807	97,392	65,414	39,474	74,045	111,379	62,834	40,000
Guinea.	35,008	37,962	31,162	23,879	58,379	51,874	41,684	28,400
Guatemala.	1,585	37,814	27,764	11,897	28,840	47,743	19,780	17,000
Cayenne.	26,543	1,193	2,329	2,614	1,364	836	19,010	28,000
Check (Guinea).	13,513	17,669	17,707	. . . .	20,171	41,845	. . . .	. . . .
Paspalum dilatatum. . .	25,103	23,675	17,913	15,511	18,588	26,719	15,000	13,780
Para.	27,140	29,453	13,180	9,460	13,480	29,160	18,404	16,530
Bugalon.	11,260	11,200	2,073	871	2,147	2,040	8,687	14,980
Check (Guinea).	14,510	23,026	14,606	. . . .	26,461	32,477	. . . .	. . . .
Uba cane.	. . . .	. . . .	. . . .	16,041	. . . .	. . . .	26,750	45,105

The following table gives the percentage of grass consumed by animals, per cutting.

Name of grass	Percentage of feed grass consumed by animals when cut at—							
	20 days old	30 days old	40 days old	45 days old	50 days old	60 days old	75 days old	90 days old
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Check (Guinea).	100	100	91	. . . .	65	69	. . . .	. . . .
Napier.	100	86	78	74	59	37	48	41
Guinea.	100	100	91	86	65	69	54	49
Guatemala.	100	100	100	100	100	95	95	82
Cayenne.	100	. . . .	. . . .	24	. . . .	33	21	15
Check (Guinea).	100	100	91	. . . .	65	69	. . . .	. . . .
Paspalum dilatatum. . . .	100	100	100	92	90	73	79	65
Para.	100	100	100	88	92	72	69	71
Bugalon.	100	100	100	100	. . . .	. . . .	100	84
Check (Guinea).	100	100	91	. . . .	65	69	. . . .	. . . .
Uba cane.	. . . .	. . . .	. . . .	98	. . . .	. . . .	95	85

In this feeding test bullocks were used. When the grass was cut at 20, 30, 40, and 45 days old, practically all parts of the plant were eaten clean by the animals. The leaves and stalks of the grasses cut after 45 days of growth had become hard and tough, and were not all relished by the animals.

The Cayenne grass becomes unpalatable as it advances in age and should be given to animals while yet young.

The leaves of *Paspalum dilatatum* and Para grasses were too dry for soiling, when the plants attained some degree of maturity.

In the case of Uba cane, Napier, Guinea, and Guatemala grasses, it is the stalks that were rejected by the animals when cuttings were made of old growth.

Cuttings of the Bugalon were all consumed regardless of the age of plant, which remained fresh and excellent throughout the year.

This experiment could give hints of the palatability alone, and would take several experiments to test on the net amounts consumed and food values as measured by increased weights of the animals fed.

Test of Sorghum, Ragi, Millet, and Adlay for forage.—To determine the value of these crops a trial plot was made during the year. Planting was made on July 6–7, 1923.

The following table gives the yields and percentage of feed consumed.

Name	Cut before flowering [1]	Cut at flowering [2]	Computed yield per hectare in kilos		Per cent of feed consumed	
			Before flowering	At flowering	Before flowering	At flowering
	Kilos	*Kilos*				
Sorghum	97.0	117.0	20,208.33	24,541.66	55	35
Ragi	36.0	56.3	9,000.00	14,075.00	100	95
Millet (sanyo)	15.5	28.4	3,875.00	7,100.00	100	80
Adlay	46.0	76.2	11,500.00	19,050.00	100	80

[1] On September 25, 81 days after date of planting.
[2] On November 28, 145 days after date of planting.

Sorghum gives most stuff, but its acceptability is low compared with other plants tried. Ragi, Millet, and Adlay were all consumed when given at flowering stage, 90 days from planting.

Propagation.—This work aims at multiplying suitable forage plants for distribution purposes.

The following table gives the names of grasses, area planted to each, etc.

Name	Date of planting	Area planted	Condition of growth
		Sq. m.	
Napier	6-10-23	982.50	Excellent.
Guinea	do	851.50	Do.
Uba cane	6-11-23	327.50	Do.
Jaragua	do	131.00	Poor.
Merker	do	65.50	Excellent.
Paspalum dilatatum	6-12-23	131.00	Good.
Bugalon	6-13-23	65.50	Fair.
Molasses	do	131.00	Very poor.
Guatemala	do	131.00	Excellent.

At present there is at Lamao ample stock of Napier and Guinea grasses for distribution and a limited quantity of Uba cane, Merker, and Guatemala grasses.

The propagation of forage crops for distribution purposes is being done at Alabang Rice Station, aside from that of Lamao. At the Alabang Rice Station, manimanian, an uncultivated native leguminous plant is being domesticated. Wide cultivation of this grass as horse feed, specially, is to be encouraged.

The varieties of sorghum, Guinea grass, Guatemala, Merker, Napier, and Uba cane are being grown at Alabang on about three-fourth of a hectare in extent.

In La Carlota the Uba cane, Para grass, Guinea, and Napier are grown, mostly as feed for the work animals.

FIBER INVESTIGATIONS

GUINOBATAN ABACA TRIAL STATION

Experiments.—Very little was done as yet in the way of experiments. One experiment set up is included to find out the age and size with which an abaca sucker must be planted so as to give the best results. Another experiment was started with a view to measuring the value of mulching in the abaca plantation. There are two ways of preparing abaca strips in vogue locally known as "lucnet" and "bacnes," and the station has committed itself to investigate which of the two is the more advantageous.

At Lamao Experiment Station—Maguey and sisal.—Small plots had been planted to maguey and sisal, for future seed stock. An experiment is in progress with these two plants, which would determine the right distance for planting them at Lamao.

Comparative yield test of agave sp., etc.—In this experiment are incorporated, the maguey, agave zapupe, Henequen, Sansevieria Zeylanica, B. Zulcata, and others. The size of the plots

vary with the number of seed plants there were available at the time of planting.

COTTON

Variety name	Computed yield per hectare in kilos	Remarks
Sea Island (Check)	....	
New Baykin	130	
Ferguson	161	
Lone star	243	
Cambadra	150	
Sea Island (Check)	74	
Kinastila	....	Not yet in bloom.
Carabonica	....	Soon to be harvested.
Toquello	14	
Cuban Brown	....	Not yet in bloom.
Sea Island (Check)	....	

Cotton planted in the month of May, June, and July died from too much rain. This suggests that the planting time should be so arranged so as to avoid putting the seeds in water clogged soil and allow both to mature during the dry season of the year.

The highest percentage of germination with cotton was recorded from seed placed in dry sawdust, giving a viability of 38 per cent after a four month keeping. This was closely approached by seed kept in charcoal. Two months afterward, the seeds tested 10 per cent and 12 per cent, when kept with sawdust and charcoal, respectively, in air tight cans.

Roselle.—The Archer, Victor, and Rico are being propagated. One hundred plants of each of the White and Red-fiber roselle were harvested. The amount of fibers extracted is 1.8 kilos from the White-fiber variety and 1.4 kilos from the Red-fiber variety.

AT LA CARLOTA EXPERIMENT STATION

Abaca.—At the La Carlota Experiment Station the fiber project has been, with the exception of some minor experiments, reduced to the maintenance of the abaca fields, necessary to meet occasional demands for suckers and seeds. There were given away in 1923, 800 suckers and 3,500 grams of seeds of abaca representing 27 varieties. The plantation, despite of the little care the station was able to give it, has been in good condition. It was possible for the station to collect specimens and to perform experiment on the relative proportion of fiber contents therein. Comparison has been made of plants from suckers and those raised from seeds. It appears from the data obtained that seedling-plants gave on the average greater percentage of

fiber, than sucker-plants. There is also probability that seedling-plants are more resistant to heartrot disease than the plants grown from suckers, according to the results.

Miscellaneous fiber plants.—There are now at La Carlota a good number of Panama hat palm suckers that can be distributed. The stripping of the fibers and bleaching were attempted there with little success.

Jute, ramie, anabo, and tikog are the other fiber plants in Lamao, worth mentioning.

206006——4

COMPARATIVE TESTS OF SIX PHILIPPINE CORN VARIETIES

By FRANCISCO D. MARQUEZ, *Agronomist, Bureau of Agriculture*

The main object of the experiments discussed in this article is to determine the comparative yields of the varieties of native corn. It is intended to carry later extensive trials of the best one or two in the different places of the Islands.

The work covered a phase of the corn breeding work of the Bureau of Agriculture at the La Carlota Experiment Station, La Carlota, Occidental Negros. The experiments were conducted in 1919 to 1921.

MATERIALS AND METHODS

The varieties used in this work were Bohol White Flint, Cebu White Flint, Moro White Flint, Baluga Yellow Flint, Cagayan Yellow Flint, and Calamba Yellow Flint. These varieties were the most promising on hand at the time of the experiment. They were introduced into the station at different times and from different places as shown in Table No. 1.

TABLE No. 1

Variety name	Date received at station	Province where obtained
Bohol White Flint	Nov. 1, 1918	Bohol.
Cebu White Flint	Aug. 1, 1918	Cebu.
Moro White Flint	1915	Leyte.
Baluga Yellow Flint	Nov. 15, 1918	Tarlac.
Cagayan Yellow Flint	April 26, 1916	Cagayan.
Calamba Yellow Flint	March 3, 1916	Laguna.

DESCRIPTION OF VARIETIES

Bohol White Flint (*See Plate No. IV–a*).—Ears, moderately cylindrical; size, medium; butts, slightly enlarged at shank, round, well filled; tips, blunt and generally exposed.

Kernels, 75 per cent of ear by weight; large, shallow on cob; length and width relatively equal; color, white, some pearly white with starchy caps; grains, flintly, well paired; rows of kernels, fairly straight and tight; typical number of rows, 14; germs, bright in color, large and cover a good length to the crown, grains easily shelled.

Cobs, medium in size, white in color.

Plants, medium in size; typical height, 2.4 m.; leaves, large and broad.

Cebu White Flint (*See Plate No. IV–b*).—Ears, slightly tapering, small; butts well shaped and nicely filled with grains; slightly enlarged at shank; tips blunt and exposed in general.

Kernels, small and deeply set on cob; longer than wide; color, pearly white with starchy caps; wedged shape, well paired; rows of kernels, fairly straight and close typical number of rows, 14; germs, bright in color, large and cover a good length to the crown; grains, easily shelled; 83 per cent of ear by weight.

Cobs, small and white. Plants, medium in size; typical height, 2.4 meters; have tendency to produce tillers and rudimentary ears.

Moro White Flint (*See Plate No. V–a*).—Ears, fairly cylindrical, large in size; butts, fairly well filled, but somewhat irregular in shape in a few cases; attachment to shank rather open; tips, blunt and generally exposed.

Kernels, large and shallow on cob; slightly longer than wide; color, pearly white, occasionally opaque; generally flinty; but with tendency to become dent; well paired; rows of kernels, fairly straight and close; typical number of rows, 14; germs, bright and large and extend well up to the crown; shelling percentage, 70.

Cobs, large and white.

The plants are large; typical height, 2.6 meters; leaves, broad and long.

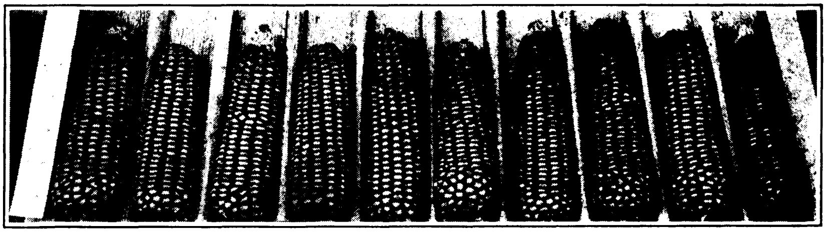
Baluga Yellow Flint (*See Plate No. V–b*).—Ears, slightly tapering; long and slender; medium in size; butts, slightly rounded and fairly well filled; tips, blunt and generally exposed.

Kernels, large, set on cob rather deep; length and width, relatively equal; color, blood red yellow, with starchy caps; flinty; well paired; rows of kernels, fairly straight and close; typical number, 12; germs, bright and large extending well up to the crown; proportion of grains to ear 76 per cent by weight.

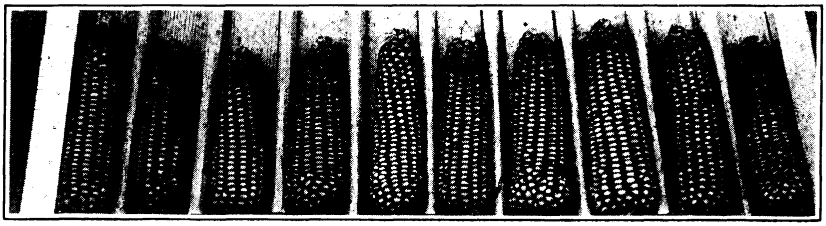
Cobs, medium in size and white in color.

The plants are of medium size; typical height, 2.5 meters; leaves are of medium length but narrow.

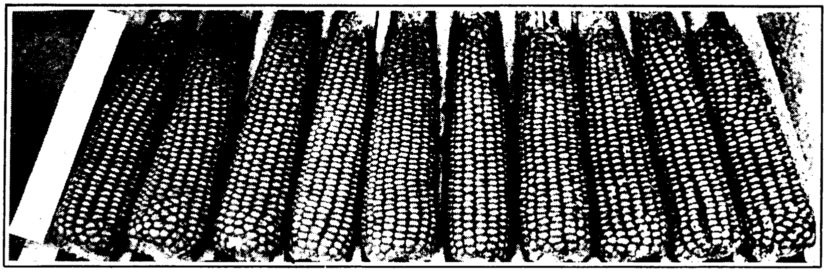
Cagayan Yellow Flint (*See Plate No. VI–a*).—Ears, tapering, rather long and slender, medium in size; butts, generally well filled but grains are unevenly set; tips, blunt and exposed.



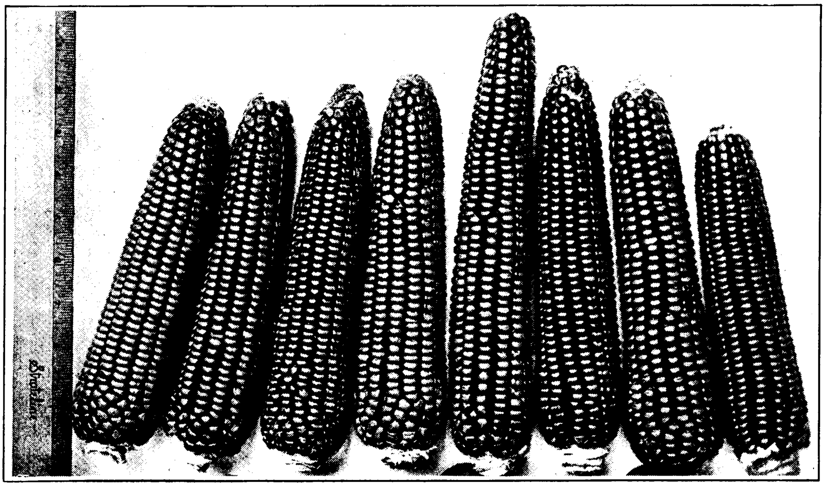
(*a*) Bohol white



(*b*) Cebu white



(*a*) Moro white



(*b*) Baluga yellow

Kernels, large and shallow on cob; rounded; color lemon yellow, rounded, with starchy caps; grains, fairly well paired; rows of kernels, fairly straight and close; typical number 12; germs, bright, large and extend quite high to the crown; grains shell at 72 per cent.

Cobs, medium in size and white in color.

The plants are of medium size; typical height, 2.5 meters; the leaves, medium in length but quite broad.

Calamba Yellow Flint (*See Plate No. VI–b*).—Ears, medium in size; tapering; butts, fairly well filled and rounded; tips, blunt and exposed.

Kernels, small and shallow on cob; nearly rounded; color, light yellow with slightly starchy caps flinty; grains, well paired and closed; 16 rows of kernels; germs, bright and large; grains, 75 per cent of ears by weight.

Cobs, medium in size and white in color.

Plants of medium size; typical height, 2.5 meters; leaves, medium in length but relatively broad.

The different varieties were planted in separate half hectare, rectangular plots, 50 meters wide. These plots were located in different but not widely separated places at the station. They were so located, however, that when the wind blew, there was less probability for the pollen grains of being carried from one plot to another.

For convenience the different plots were designated as Plot A, Plot B, Plot C, Plot D, Plot E, and Plot F. The original idea was to plant each variety in each plot in succession. Between Plots E and F, which were near each other, a windbreak five meters high made of bamboo and native grass (tigbao) was constructed. The object was to prevent or at least reduce the chance of cross-pollination between the varieties planted in these two plots.

As a means of minimizing the error that might arise due to difference in soil fertility, two check-rows were planted in the middle of each plot parallel to the rows of corn. It will be noted elsewhere in this article that due correction was made in the results because of possibility of error resulting from this difference in soil fertility.

In this experiment efforts were made to keep every culture as pure as possible. This end was attained partly by constant and

thorough selection and elimination of foreign grains that appeared in the product and by planting each variety by itself.

The ground in all the plots was prepared as uniformly as possbile.

The spacing of one meter between the rows and 50 centimeters between the hills was uniform throughout the field. Three to two seeds were planted to the hill but only one plant was allowed to develop in each hill.

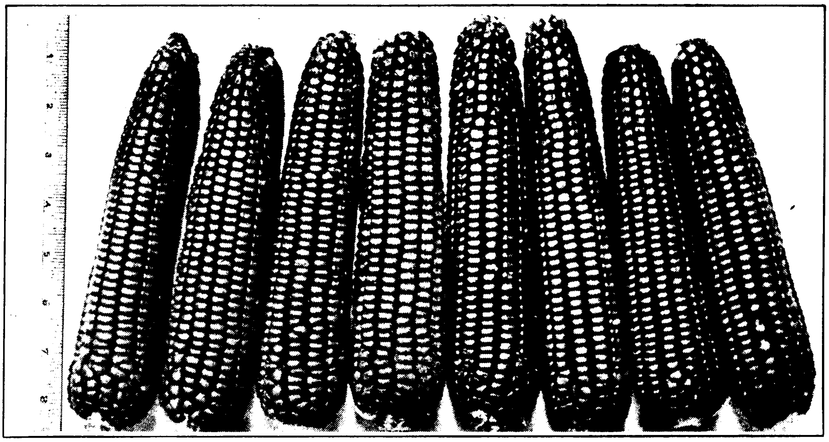
The following table shows in detail the results of the tests and other data:

TABLE No. 2

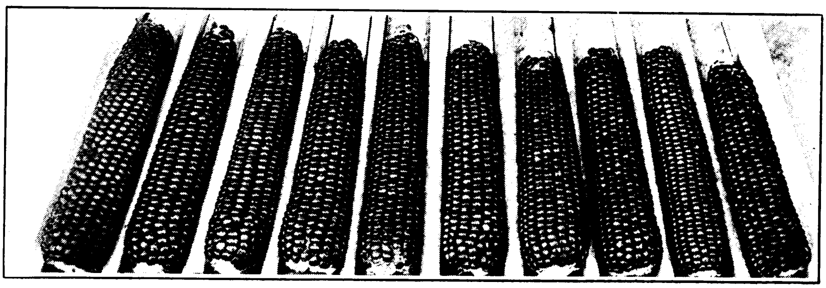
Test No.	Variety name	Area planted	Date planted	No. of days from planting to maturity	Percentage		
					Stand	Shelling	Shrinkage
		Hectare		*Days*			
1	Bohol White Flint	0.5	9-19-19	108	70.82	70.00	33.61
2	Do	0.5	4-30-20	100	81.46	77.83	32.50
3	Do	0.5	11-22-20	107	79.93	77.11	31.25
	Total					224.94	97.36
	Average					74.98	32.45
1	Cebu White Flint	0.5	9-19-19	104	85.36	80.00	27.35
2	Do	0.5	4-30-20	100	78.26	86.65	30.61
3	Do	0.5	11-22-20	106	81.67	80.09	31.25
	Total					247.74	89.21
	Average					82.25	29.74
1	Moro White Flint	0.5	9-19-19	100	94.87	66.42	27.55
2	Do	0.5	4-30-20	98	72.40	70.99	21.94
3	Do	0.5	11-22-20	103	71.88	71.20	25.88
	Total					208.61	75.37
	Average					69.54	25.12
1	Baluga Yellow Flint	0.5	9-19-19	96	69.12	74.00	31.22
2	Do	0.5	4-30-20	96	76.34	76.20	27.65
3	Do	0.5	11-22-20	102	77.36	78.33	27.34
	Total					228.53	86.21
	Average					76.17	28.74
1	Cagayan Yellow Flint	0.5	9-19-19	96	80.74	65.00	25.86
2	Do	0.5	4-30-20	97	73.78	75.66	23.91
3	Do	0.5	11-22-20	109	67.21	74.75	27.65
	Total					215.41	77.42
	Average					71.80	25.81
1	Calamba Yellow Flint	0.5	9-19-19	96	84.95	69.69	25.50
2	Do	0.5	4-30-20	93	79.10	77.27	29.78
3	Do	0.5	11-22-20	105	75.68	76.38	22.20
	Total					223.34	77.48
	Average					74.45	25.83

Standard used for computed yield based on check crop:

	Kilos
Average of first series	38.33
Average of second series	44.67
Average of third series	29.40



(*a*) Cagayan yellow



(*b*) Calamba yellow

TABLE No. 3

Yield per hectare shelled corn			No. of days of rain	Amount of rainfall during period of growth	Remarks
Based on actual crop harvested	Corrected based on 100 per cent stand	Corrected based on check crop			
Cavan	*Cavan*	*Cavan*		*mm.*	
16.46	23.24	11.75	58	888.5	Typhoon occurred during early stage of growth. Soft-rot, stalk and ear borers attacked plants. Maturity of plants uniform.
27.64	33.93	....	62	1,469.1	
27.52	34.43	19.08	29	329.4	
71.62	91.60	30.83	....	....	
23.87	30.53	15.41	....	....	
20.13	23.58	24.92	57	883.9	Typhoon occurred during early period of growth. Soft-rot, stalk and ear borers attacked plants. Maturity uniform.
27.56	35.22	31.93	62	1,469.1	
31.58	38.67	27.71	29	329.4	
79.27	97.47	84.66	....	....	
26.42	32.49	28.22	....	....	
23.58	24.85	21.23	55	876.7	Typhoon occurred during early stage of growth. Soft-rot, stalk and ear borers attacked plants. Maturity fairly uniform.
32.58	45.00	33.97	61	1,468.1	
25.24	35.11	24.76	28	328.9	
81.40	104.96	79.96	....	....	
27.13	34.98	26.65	....	....	
16.16	23.38	18.41	51	866.0	Typhoon occurred during early stage of growth. Soft-rot, stalk and ear borers attacked plants. Maturity quite uniform.
44.76	58.64	38.37	60	1,442.8	
33.22	42.94	26.75	28	326.9	
94.14	124.96	83.53	....	....	
31.38	41.65	27.51	....	....	
10.16	12.58	12.51	51	866.0	
36.66	49.69	30.43	61	1,468.1	Do.
28.39	42.24	36.28	29	329.4	
75.21	104.51	79.22	....	....	
25.07	34.84	26.40	....	....	
20.61	24.26	20.76	51	866.0	
41.44	52.39	32.19	58	1,441.5	Do.
21.30	28.24	....	28	326.9	
83.35	105.89	52.95	....	....	
27.78	35.29	26.47	....	....	

DISCUSSION OF RESULTS

It will be recalled that the cultures were conducted during distinctly different seasons of the year. An attempt was made to show the effect of the varying amount of rainfall during the growing period of a variety.

In the first series, on account of the damage caused by typhoons which injured the growing plants at the early stage of growth, only 0.25 hectare was used as the basis for computation of yield per hectare although 0.5 hectare was actually planted to each variety. In all other series, however, one-half (0.5 hectare) was used as the basis.

Baluga Yellow Flint, as may be seen in Table 2, outyielded every other variety in the test. Bohol White Flint was the lowest yielder giving an average of 23.87 cavans of shelled corn per hectare. The increase of the Baluga Yellow Flint over this variety is 7.51 cavans or 23.6 per cent and 3.6 cavans over the

Calamba Yellow Flint, the second highest yielder. This increase is equivalent to 11.1 per cent.

The Baluga Yellow Flint also outyielded every other variety in the yield based on stand. An increase of 6.36 cavans per hectare or 15.2 per cent was made over Calamba Yellow Flint, the second highest yielding variety in the test. The increase over Bohol White, the lowest yielder, amounted to 11.12 cavans or 26.9 per cent. The Baluga Yellow Flint outyielded also all varieties except Cebu White but the difference was almost negligible.

SUMMARY OF CONCLUSIONS

The Baluga Yellow Flint was the highest yielder of the varieties tested and the average yields per hectare, in three successive seasons were 31.38, 41.65, and 27.57 cavans shelled corn, based on 100 per cent stand and based on check crop, respectively.

Baluga Yellow Flint besides being a high yielder was also a uniform and early maturing variety of corn.

Baluga Yellow Flint and Cebu White Flint did the best during the dry season, the yields per hectare being 33.22 cavans and 31.58, respectively. Calamba Yellow Flint was a good wet season corn, although Baluga Yellow Flint outyielded it also as well as the others used in the test.

Baluga Yellow Flint has shown the best results for both the wet and dry season plantings.

Moro White Flint was the least susceptible to soft-rot disease and stalk and ear borers while Cebu White Flint the most susceptible. Soft-rot, stalk, and ear borers were more prevalent during the rainy season than during the dry season.

FOOD VALUE

Analyses made at the Bureau of Science of the different varieties used in this test showed that the variation in the proteins, fats, and carbohydrate contents was very little except in the case of Bohol White Flint and Cagayan Yellow Flint where the difference was quite appreciable as regards protein content, and in the case of the Cagayan Yellow Flint the fat content of this variety was quite big.

The different varieties had practically the same value in cooking quality, when the corn was boiled green. They were equally as sweet and flinty. Roasting Cebu White Flint, on account of the kernel being deeply set on cobs, is quite disadvantageous as while a greater portion of the kernels remain uncooked the other portion is already quite well burned. In rice-corn preparation, however, it was observed that the Cebu White Flint is the best,

the kernels presenting a hard rice-like appearance which when cooked may be mistaken for real rice.

As to color, there are some who like the white while others, the yellow although there is practically no difference in the result of the choice.

Varieties	Protein	Fat	Carbo-hydrates
	Per cent	*Per cent*	*Per cent*
Moro White Flint	7.21	4.31	73.48
Cebu White Flint	7.35	4.21	74.17
Bohol White Flint	6.61	4.32	74.83
Baluga Yellow Flint	7.65	4.46	74.28
Cagayan Yellow Flint	6.78	6.15	73.12
Calamba Yellow Flint	7.56	4.66	73.65

ACKNOWLEDGEMENT

Acknowledgment is due Messrs. Leoncio F. Dario and Teodoro Corpus, Assistant in Agronomy and Agriculture Assistant, respectively, who assisted the writer in the preparation and execution of the work reported in this paper.

The writer is indebted to Professor N. B. Mendiola, former Consulting Plant Breeder, Bureau of Agriculture; Mr. M. Manas y Cruz, Chief, Plant Industry Division; and Mr. Victorino Borja, Agronomist; for reading the manuscript and giving valuable suggestions.

EXPERIMENTS ON VEGETATIVE PROPAGATION OF TROPICAL FRUITS AT THE LAMAO EXPERIMENT STATION, LAMAO, BATAAN

By F. G. GALANG AND ANIANO R. ELAYDA

Investigational work on the vegetative propagation of tropical fruit trees is one of the principal activities carried on under Miscellaneous Tropical Fruits project at the Lamao Experiment Station. The results of the work along this line previous to 1921 have been reported and published from time to time in THE PHILIPPINE AGRICULTURAL REVIEW, "THE PHILIPPINE FARMER," and Bulletin No. 32, Plant Propagation in the Tropics, by P. J. Wester.

Most of the directions given below are drawn from the results of recent trials conducted by one of the authors, Aniano R. Elayda, Assistant in Horticulture of the Bureau of Agriculture, formerly assigned to Lamao Experiment Station.

SHIELD BUDDING

ORANGE, *Citrus sinensis, Pummelo, C. maxima, and Calamondin, C. mitis rebudded on Vilatti, Feronia limonia and viceversa.*—Use either petioled or non-petioled rather matured but green-colored budwood; cut the bud from 2 to 3 centimeters long and insert it in the stock where the bark is from greenish to light brown in color.

IBA, *Cicca acida budded on Nelli, Phyllanthus emblica.*—Use either petioled or non-petioled, light green colored budwood; cut the bud 3.5 to 4 centimeters long and insert it in the stock where the bark is grayish green.

SEAGRAPE (*Coccoloba sp.*) *budded on Nelli* (*Phyllanthus emblica*).—Use non-petioled budwood of second growth; cut the bud from 4 to 5 centimeters long; age of stock at the point of insertion is unimportant.

At the Singalong Propagating and Testing Station Rima (*Artocarpus communis*) was also successfully budded on Camansi (*Artocarpus sp.*).

CLEFT GRAFTING

KARANDA, *Carissa carandas grafted on Perunkila, Carissa sp.*—Use well matured scion, 8 to 10 centimeters long and 7 to 10 millimeters in diameter, with 2 or 3 nodes; insert it in a stock of nearly the same size and color as the scion.

PILI, *Canarium ovatum grafted on Pisa, Canarium luzonicum.*—Use non-petioled scion, 8 to 10 centimeters long and 8 to 10 millimeters in diameter; insert it in a stock at the point of nearly the same age and size as the scion.

KAYAN, *Inocarpus edulis grafted on Kayan.*—Use non-petioled, well matured scion, 8 to 10 centimeters long and 8 to 10 millimeters in diameter; insert it in a stock at the point of nearly the same age and size as the scion.

LITCHI, *Litchi chinensis grafted on Laguan, Nephelium sp.*—Use non-petioled brownish gray and matured scion; cut the scion 8 to 12 centimeters long and insert it at the stock of nearly the same size, age, and color.

LIME, *Citrus aurantifolia grafted on Limoncito, Triphasia trifola.*—Use petioled, rather mature but green colored scion; cut the scion 7 to 10 centimeters long and insert it in the stock of nearly the same size as the scion.

BANAUAK, *Uvaria rufa grafted on Maron, Annona montana.*—Use non-petioled scion, 8 to 10 centimeters long and about one centimeter in diameter; age and size of stock unimportant.

DALINSI, *Terminalia edulis grafted on Dalinsi.*—Use petioled or non-petioled scion but rather matured and brownish in color; cut the scion so that it will contain 3 to 4 nodes. Insert it in the stock of nearly the same age and size.

DALINSI, *Terminalia edulis grafted on Talisay, T. catapa.* Directions same as that for Dalinsi.

INARCHING

The following plants have been successfully inarched:

PILI, *Canarium ovatum* on Pisa, *C. luzonicum.*

RIMA, *Artocarpus communis* on Jak, *A. integra.*

RIMA, *Artocarpus communis* on Gomihan, *A. elastica,* and vice-versa.

LEMASA, *A. champeden* on Jak, *A. integra.*

RIMA, *A. communis* on Camansi, *A. sp.*

MARCOTTAGE

Various species of Citrus, Yambo, *Eugenia sp.* Makopa, *Eugenia javanica* and the Rima, *Artocarpus communis* were success-

fully marcotted. Use vigorous and symmetrical branches with a diameter of from 2 to 6 centimeters. Perform the operation during the rainy season. The marcots should be watered from time to time during the dry season.

CUTTINGS

Cuttings of the following plants have been successfully grown. Pangao, *Sterculia oblongata,* Iba, *Cicca acida,* Hondapara, *Dillenia indica,* Tersana, *Eugenia malaccensis,* Ketembilla, *Dovyalis hebecarpa,* Palali, *Dillenia reifferscheidia* and Vilatti, *Feronia limonia.*

VARIETY TEST OF CABBAGE

By E. K. MORADA, *Assistant in Horticulture*

This experiment was conducted with the object of finding out the relative merits of the different varieties of cabbage when grown side by side. The results presented here are to be considered only in soils similar to that of Lamao Experiment Station, Lamao, Bataan and climatic conditions prevailing there where the experiment has been carried out. The experiment was performed from October, 1921, to April of the following year.

MATERIALS AND METHODS

VARIETIES USED

Seeds of the following varieties were obtained in 1921 from T. W. Wood and Sons, Richmond, Virginia, United States of America.

1. Early Jersey Wakefield.
2. Early Flat Dutch.
3. Solid South.
4. Wood's Extra Early.
5. Late Flat Dutch.
6. Sure Head.
7. Early Winningstadt.
8. Henderson's Early Summer.

There was no data as to the age of the seeds or whether the seeds used in this experiment were harvested from plants planted at different times. The vitality of the seeds influence more or less the yield of the variety in question. However, the seeds were grown under the same conditions and at the same time, so that the effect in yield, if any, would be very slight.

DESCRIPTION OF VARIETIES

1. *Early Jersey Wakefield.*—An early variety with solid, very compact, heavy, conical heads, averaging 0.63 kilo in weight. It is a fair producer of heads.

2. *Early Flat Dutch.*—Another early variety with solid almost round, flat heads, averaging 0.34 kilo in weight.

3. *Solid South.*—A late variety with big solid, as the name indicates, nearly round heads, averaging 0.58 kilo in weight.

It is a good producer and well adapted to Lamao conditions. It ranks second in yield.

4. *Wood's Extra Early.*—An early variety, producing, nearly round, solid heads, weighing 0.38 kilo.

5. *Late Flat Dutch.*—A late variety, with big solid, almost round flat heads, with an average weight of 0.72 kilo. It is the best producer among the varieties and is an excellent variety for planting under Lamao conditions.

6. *Sure Head.*—A late variety, with big, solid nearly round heads, averaging 0.61 kilo in weight. It is not a very sure producer, and ranks third in yield.

7. *Early Winningstadt.*—Another early variety producing sharp conical and small, very solid heads weighing 0.41 kilo. The leaves are shorter than those of the other varieties. It is the best producer of heads.

8. *Henderson's Early Summer.*—Another early variety producing fairly big, nearly round, solid heads, averaging 0.52 kilo in weight.

CLASSIFICATION

In order to distinguish the different varieties and to give the advantages and disadvantages of each type, an attempt was made to classify them for the information of those who desire to plant them, as follows:

1. *Late and early varieties.*—The lateness or earliness of a variety is influenced by the soil and climatic conditions. The varieties that are late or early in the United States may not be so in our locality. The plantings made were not enough to give sufficient and reliable data to warrant their classification into late and early varieties. Consequently, this classification is not used.

2. *Varieties producing round heads and varieties producing conical heads.*—(*a*) Varieties belonging to the round type of heads are:

1. Early Flat Dutch.
2. Solid South.
3. Wood's Extra Early.
4. Late Flat Dutch.
5. Sure Head.
6. Henderson's Early Summer.

(*b*) Varieties belonging to the conical type of heads are:

1. Early Jersey Wakefield.
2. Early Winningstadt.

The best yielders and producers of the biggest and heaviest heads were found among the round type of heads. However, this type is not a sure producer of heads as the other type. The varieties of the conical type are not good yielders as stated above but they are the best producers of heads.

PLAN OF WORK

Table I shows the rainfall during 1921–22.

The ground used in this experiment is a slight slope which can be irrigated easily. The ground which is clay loam, was previously planted to other crops. It was divided into eleven beds each measuring 1.3 meters wide, 9 meters long and 10 centimeters high. Between the beds were paths, 50 centimeters wide. They were made parallel to the slope of the ground. The beds were dug up with spading fork and raked thoroughly twice, to make them level and to pulverize the soil. Before digging the soil, four wheelbarrows of composted soil weighing about 161.4 kilos were spread on each bed, and mixed thoroughly.

Each variety was planted in each bed. Three check beds were provided for; one at each end and one at the center of the field to determine any variation in the fertility of the soil. The early Jersey Wakefield was used as the check variety. Table 2 gives the arrangement of the beds and the variety planted in each bed.

The seeds were sown in seed flats on October 14, 1921, and picked to other flats on October 20 and 21, 1921. On November 12, 1921, the seedlings were transplanted, when the third pair of leaves appeared, in the beds at a distance of 50 by 50 centimeters. They were shaded from the heat of the sun with banana sheaths of about 30 centimeters long for 5 consecutive days. During the first two weeks they were watered every day with the aid of a sprinkling can, but afterwards they were irrigated twice a week by the flooding system. The water was allowed to run along the paths, and it was thrown carefully into the beds.

Cultivation was performed twice a week with the planet junior cultivator and supplemented with a garden hoe.

The percentage of heading, the date, number, and weight of heads, harvested from each bed were recorded.

YIELD

The yield per hectare was taken as the basis of computation. The heads destroyed by worms were included in the computation of yield. Table 2, gives the method of computing the yield.

From the yields of the check variety on beds, 1, 6, and 11 which were 26,863.24; 25,649.57; and 26,769.23 kilos respectively, it could be seen that the soil is richer from the center toward the two ends of the field employed and that the end where the check No. 1 was, was slightly richer than the other end. Consequently, the theoretical yields would increase from the center toward the two ends or it would decrease from the ends to the center. The results, obtained by dividing the difference in the yields of the two succeeding checks with the number of beds, lying between the two checks, plus one bed of the checks just treated, would be the amount by which each theoretical yield of the imaginary checks increases from the center to check No. 1, beginning from the lower yield of the check. The theoretical yields of the imaginary checks, occupied by the non-check varieties were substracted algebraically from the corresponding actual yields of the varieties, planted between the two checks to get the computed theoretical yield of each bed, planted to each variety.

DISCUSSION OF RESULTS

Table 4, gives the summary of results.

From this table it can be seen that the percentage of germination of the different varieties varies from 60 per cent to 85 per cent.

Not all the cabbage plants of all the varieties produced heads. They varied from 78 per cent to 92 per cent, depending upon the variety. Early Winningstadt has the highest percentage of productivity, which is 92 per cent; Wood's Extra Early, second with 90.19 per cent; Early Jersey Wakefield, third with 88.13 per cent (taking into consideration all the beds planted to this latter variety); Early Flat Dutch, fourth with 86.27 per cent; Solid South and Henderson's Early Summer, fifth with 84.31 per cent each; Late Flat Dutch, sixth with 82.35 per cent; and Sure Head, last with 78 per cent. In general, the varieties, producing conical heads are better producers of heads than those producing round ones.

The Solid South, Wood's Extra Early, Late Flat Dutch, Sure Head, Early Jersey Wakefield, and Henderson's Early Summer varieties produced matured heads in 130 days from the time of planting and the Early Dutch and Early Winningstadt in 139 days.

As to the computed yield per hectare the Late Flat Duch was the heaviest yielder which produced 26,338.45 kilos to the hectare; Solid South, second with 21,399.99 kilos; Sure Head, third with 20,694.86 kilos; Henderson's Early Summer, fourth with 11,869.22 kilos; Early Winningstadt fifth with 16,212.81 kilos; Wood's Extra Early, sixth with 15,112.81 kilos; Early Jersey Wakefield, seventh with 13,864.09 kilos; and Early Flat Dutch was last with 12,439.30 kilos.

With regard to the average weight of heads the Late Flat Dutch, produced, the heaviest weighing 0.72 kilo; Sure Head, second, 0.61 kilo; Solid South, third, 0.58 kilo; Henderson's Early Summer, fourth, 0.52 kilo; Early Jersey Wakefield, fifth, 0.42 kilo; Early Winningstadt, sixth, 0.41 kilo; Wood's Extra Early, seventh, 0.38 kilo; and Early Flat Dutch, eighth, 0.34 kilo.

The varieties, producing the highest number of heads were not necessarily, the heaviest yielders. Heavy yielding depends upon the variety and the characteristics of the heads produced. The varieties with conical heads did not produce big heads and consequently they were not as good yielders as those with round and flat heads.

SUMMARY OF CONCLUSIONS

1. The varieties with conical heads are better producers of heads than those with round heads.
2. Late Flat Dutch, Solid South, Sure Head, Henderson's Early Summer, and Early Winningstadt are the best yielders in the order of their enumeration.
3. Late Flat Dutch, Sure Head, Solid South, Henderson's Early Summer, and Early Jersey Wakefield produce the biggest heads, in the order of their enumeration.

TABLE 1.—*Rainfall for 1921–1922*

Month	Rainfall	
	1921	1922
	Inches	*Inches*
January	....	....
February	0.5	....
March	.4	....
April	....	2.00
May	7.71	10.42
June	6.36	9.30
July	10.00	35.12
August	55.50	8.62
September	8.20	18.91
October	2.62	7.98
November	16.74	1.66
December	.23	5.37
Total	108.26	99.38

TABLE 2.—*Arrangement of beds and the variety planted in each bed*

Bed No.	Variety name	Check No.
1	Early Jersey Wakefield	Check I.
2	Early Flat Dutch	
3	Solid South	
4	Wood's Extra Early	
5	Late Flat Dutch	Check II.
6	Early Jersey Wakefield	
7	Sure Head	
8	Early Jersey Wakefield	
9	Early Winningstadt	
10	Henderson's Early Summer	
11	Early Jersey Wakefield	Check III.

TABLE 3.—*Method of yield computation*

Bed No.	Variety name	Actual yield per bed	Actual yield per hectare	Theoretical yield per hectare of non-check beds	Difference beween actual yield and theoretical yield in these rows	Average theoretical yield of check rows	Theoretical yield per hectare of non-check beds
		Kilos	*Kilos*	*Kilos*	*Kilos*	*Kilos*	*Kilos*
1	Check No. 1	31.43	26,863.24	....	....	....	....
2	Early Flat Dutch	14.98	12,803.41	26,620.50	—13,817.096	26,256.40	12,439.30
3	Solid South	25.18	21,521.36	26,377.77	— 4,856.412	26,256.40	21,399.99
4	Wood's Extra Early	17.54	14,991.45	26,135.03	—11,143.588	26,256.40	15,112.81
5	Late Flat Dutch	30.39	25,974.35	25,892.30	82.046	26,256.40	26,338.45
6	Check No. 2	30.01	25,649.57	....	....	....	....
7	Sure Head	23.82	20,358.97	25,873.50	— 5,514.532	26,209.40	20,694.86
8	Early Jersey Wakefield	16.09	13,752.13	26,097.45	—12,345.304	26,209.40	13,864.09
9	Early Winningstadt	19.10	16,324.78	26,321.36	— 9,996.586	26,209.40	16,212.81
10	Hendarson's Early Summer	22.47	19,205.12	26,545.29	— 7,340.178	26,209.40	18,869.22
11	Check No 3	31.32	26,769.23	....	....	....	....

REMARKS: In the actual yield per bed, the heads, destroyed by worms were included.
Source—T. W. Wood's & Sons, Richmond, Virginia, United States of America.
Date of planting—October 14, 1921.
Amount planted in each bed—2 grams.
Method—Broadcasting in seedflats.
Date of Germination—October 17, 1921.
Date pricked—October 20–21, 1921.
Date of transplanting—November 14, 1921.
Spacing in centimeter—50 by 50 centimeters.
Method—Transplanted in rows in bed.
Area planted in square meter—117 square meters (individual bed).
Cultivation required—Twice a week.
Method—By the use of planet junior cultivator supplemented by hoeing.
Irrigation—Twice a week.
Method—By flooding.
Fertilizer used—Four wheelbarrows (161.4 kilos) Compost applied in each bed.

TABLE 4.—*Summary of results of experiment*

Bed No.	Variety name	Germination	Number of plants	Number of plants with heads	Heading	Date harvested	Number of heads harvested	Actual yield	Average weight of head	Computed yield per hectare	Rank in yield per hectare	Rank in average weight of head
		Per cent			*Per cent*			*Kilos*	*Kilos*	*Kilos*		
1	(C) Early Jersey Wakefield	....	50	46	92.00	2-14—3-10-22	32	21.91	0.68	....	....	....
2	Early Flat Dutch	80	51	44	86.27	3—2-10-22	21	7.16	.34	12,439.30	8	8
3	Solid South	80	51	43	84.31	2-21—3-10-22	28	16.48	.58	21,399.99	2	3
4	Wood's Extra Early	75	51	46	90.19	2-21—3-10-22	25	9.56	.38	15,112.81	6	7
5	Late Flat Dutch	80	51	42	82.35	2-21—3-10-22	23	16.71	.72	26,338.45	1	1
6	(C) Early Jersey Wakefield	....	44	42	95.45	2-21—3-10-22	23	16.52	.71	....	....	....
7	Sure Head	80	50	39	78.00	2-21—3- 7-22	19	11.62	.61	20,694.86	3	2
8	Early Jersey Wakefield	85	48	38	79.17	2-21—3-10-22	23	9.79	.42	13,864.09	7	5
9	Early Winningstadt	60	50	46	92.00	3—2-10-22	29	12.13	.41	16,212.81	5	6
10	Henderson's Early Summer	70	51	43	84.31	2-21—3-10-22	28	14.67	.52	18,869.22	4	4
11	(C) Early Jersey Wakefield	....	49	42	85.91	2-21—3-10-22	26	19.48	.74	....	....	....

REMARKS:

Beds 1, 6, and 11 are the check beds.
The heads, destroyed by worms were included in the calculation of yield.
The plants were allowed to develope to let them flower after removing the heads. No flowers were produced.

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF AGRICULTURE

MANILA, *July 29, 1924.*

Subject: **Regulations Governing Certain Phases of the Grading, Baling, and Inspection of Philippine Fibers**

ADMINISTRATIVE ORDER NO. 44

In accordance with the provisions of Article III of Chapter 46 of Title VII of Book II of the Revised Administrative Code, the following regulations governing certain phases of the grading, baling, and inspection of Philippine fibers are hereby issued for the information and guidance of all concerned:

These regulations cover the following subjects, namely: (1) Designation of the official standard grades for each fiber included in Article III of Chapter 46 of Title VII of Book II of the Revised Administrative Code; (2) determination of the standard grades and types thereof; (3) additional regulations regarding baling, labeling, and inspection; and (4) cancellation of previous Administrative Order.

ARTICLE I.—*Designation of official standard grades*

The following named Philippine fibers are included under these regulations and a separate set of standard grades is established for each:

(1) Abaca: Of excellent cleaning, specially prepared for tagal braid or other fine textile purposes.
(2) Abaca: Of excellent or good cleaning.
(3) Abaca: Strips or partially cleaned fiber.
(4) Abaca: Woody and waste fibers.
(5) Maguey or Sisal: Retted.

(6) Cantala (maguey) or Sisal: Knife- or machine-cleaned.

(7) Pacol and Canton.

SECTION 1. *Abaca: Of excellent cleaning, specially prepared for tagal braid or other fine textile purposes.*—The following grades shall be the official standards of classification for this fiber only when the product is carefully sorted; cleaned of all tow; of more uniform color, cleaning and texture than is required in subsequent standards:

Letter designation	Name of grade
AA	Tagal-one.
BB	Tagal-two.
CC	Tagal-three.
DD	Tagal-four.
EE	Tagal-five.

SEC. 2. *Abaca: Of excellent or good cleaning.*—The following grades shall be the official standards of classification for this fiber only when the product is in the form of fiber, i. e., well cleaned:

Letter designation	Name of grade
A	Extra Prime.
B	Prime.
C	Superior Current.
D	Good Current.
E	Midway.
S1	Streaky No. 1.
S2	Streaky No. 2.
S3	Streaky No. 3.
F	Current.
G	Seconds.
H	Brown.

SEC. 3. *Abaca: Strips or partially cleaned fiber.*—There shall be six grades of abaca when the fiber is prepared in the form of strips, which shall be designated as follows:

Letter designation	Name of grade
I	Good Fair.
J1	Fair No. 1.
J2	Fair No. 2.
K	Medium.
L	Coarse.
M	Coarse Brown.

SEC. 4. *Abaca: Woody and waste fibers.*—There shall be twelve grades of abaca when the fiber is hard and woody, damaged, or in the form of strings tow or waste, which shall be designated as follows:

Letter designation	Name of grade
DL	Daet Coarse.
DM	Daet Coarse Brown.
O1	Strings No. 1 (Grades A to I, inclusive).
O2	Strings No. 2 (Grades J1 to K, inclusive)
O3	Strings No. 3 (Grades L to DM, inclusive)
T1	Tow No. 1 (Grades A to I, inclusive).
T2	Tow No. 2 (Grades J1 to K, inclusive).
T3	Tow No. 3 (Grades L to DM, inclusive).
Y1	Damaged No. 1 (Grades A to I, inclusive).
Y2	Damaged No. 2 (Grades J1 to K, inclusive).
Y3	Damaged No. 3 (Grades L to DM, inclusive).
W	Waste.

SEC. 5. *Maguey or Sisal: Retted.*—There shall be seven grades of maguey or sisal when the fiber is separated by retting the leaves in water. These grades shall be designated as follows:

Letter designation	Name of grade
MR or SR 1	Maguey or Sisal No. 1.
MR or SR 2	Maguey or Sisal No. 2.
MR or SR 3	Maguey or Sisal No. 3.
MR or SR O	Maguey or Sisal Strings.
MR or SR T	Maguey or Sisal Tow.
MR or SR Y	Maguey or Sisal Damaged.
MR or SR W	Maguey or Sisal Waste.

SEC. 6. *Cantala (maguey) or Sisal: Knife- or machine-cleaned.*—The grades for either cantala or sisal when cleaned by machinery or by knife shall be nine in number, designated as follows:

Letter designation	Name of grade
CL or SL A	Cantala or Sisal, Good.
CL or SL B	Cantala or Sisal, Fair.
CL or SL C	Cantala or Sisal, Common.
CL or SL R	Cantala or Sisal, Red.
CL or SL S	Cantala or Sisal, Very Short.
CL or SL O	Cantala or Sisal, Strings.
CL or SL T	Cantala or Sisal, Tow.
CL or SL Y	Cantala or Sisal, Damaged.
CL or SL W	Cantala or Sisal, Waste.

SEC. 7. *Pacol and Canton.*—These fibers are produced in certain parts of the Philippine Islands from plants known by the same names, which resemble both abaca and banana. Although Canton is stronger than Pacol, both are considerably weaker than abaca and the adulteration of one with the other and the mixing of either or both with abaca is strictly prohibited.

Pacol shall be graded as Pacol No. 1 (Pcl 1), the well-cleaned fiber (white or dark), and Pacol No. 2 (Pcl 2), the strips or partially cleaned fiber.

There shall be as many grades of Canton as there are for abaca, but the letter-designation must in all cases be preceded by the letters *"Can,"* as *"Can F,"* etc., in the case of Canton fiber.

The basis of classification of Canton fiber shall be the same as that adopted for abaca of the same grades, and shall be based mainly on color and cleaning.

The above-mentioned fibers shall be graded under separate lot numbers from those of abaca and other fibers, and separate certificates shall be issued for them by the fiber inspector.

Abaca fiber that has been adulterated with either Canton or Pacol fiber in such a way as to make it impracticable to separate the two, shall be graded as Canton or Pacol without regard to the percentage of pure abaca fiber that may be mixed with either of these two inferior fibers.

All bales of Canton or Pacol fiber shall have printed across the bales in types at least 3 inches high the word *"Canton"* or *"Pacol"* in addition to the Government grading letter-designation and the Government stamp on the muslin tag in the bale.

ARTICLE II.—*Designation of grades and types*

The grading of fiber in standards included in Article I of this order shall be based on its tensile strength, color, and cleaning, except Pacol and Canton fibers which shall be based mainly on color and cleaning, as follows:

Tensile strength.—This is a basic quality, and under this system the fibers must possess an average normal breaking strength in order that it may be graded to any of the standards established in this order; otherwise, it will be graded as "damaged." (*See* section 4, Article I.) If the proportion of weak or damaged fiber in a lot is not sufficiently high to justify the above action, then the only recourse shall be the rejection of the whole lot for sorting the weak fiber from that of normal strength. Ordinarily, practical observation and hand tests are sufficient to indicate whether or not a certain fiber possesses normal strength. In cases of doubt or dispute, however, the fiber inspector shall verify his finding by making tests with adequate strength-testing machines provided by the Government for this purpose.

Color.—The tensile strength of a lot of fiber being good, the practical grading operation will be based on its color.

This quality, therefore, is the determining factor of grading well-cleaned abaca and knife- or machine-cleaned cantala (maguey) and sisal. The color of the abaca fiber ranges from brown or purple to white, and the extent of variation allowable between one grade and another is illustrated by standard samples prepared by the fiber division of the Bureau of Agriculture. These samples may be obtained by graders and buyers upon payment in advance of ₱1 per sample.

Cleaning.—The method or extent of cleaning (fiber extraction), often produces radical changes in the character and usefulness of the fiber, hence the establishment of a separate set of standard grades for abaca strips and one for retted maguey and sisal. In the grades included under these two sets of standards, the extent of cleaning is the determining factor, although color is also taken into consideration.

In describing the cleaning of the fiber in the certificates of inspection the following terms will be used:

"Excellent," when the cleaning is perfect or nearly so, the product being pure fiber, as in the tagal grades (*see* section 1, Art. I) and also the grades "Extra Prime" to "Streaky No. 3" (*see* section 2, Art. I); in the grades "Cantala or Sisal A to C" (knife- or machine-cleaned) (*see* section 6, Art. I); and in the grades "Maguey or Sisal No. 1" (*see* section 5, Art. I).

"Good," in the case of abaca, when the product is somewhat strippy, but the strips are fine, soft, and more or less intermixed with pure fiber, as in the grades "Current," "Seconds," "Brown," and sometimes "Good Fair;" and in the case of retted maguey and sisal, when the fiber is to a small extent spotted with hard, gummy scales, as in the grade "Maguey or Sisal No. 2."

"Fair," in the case of abaca, when the product is distinctly strippy but the strips are narrow and thin, as in the grades "Good Fair," "Fair No. 1," "Fair No. 2," and "Medium;" and in the case of retted maguey and sisal, when the gummy scales on the fiber are more or less prominent, as in the grades "Maguey or Sisal No. 3."

"Coarse," when the product is entirely strippy, and the strips are wide, pulpy, or both, as in the grades "Coarse," "Coarse Brown," and the two Daet grades.

In addition to strength, color, and extent of cleaning, there are two other characteristics in a fiber which do not

affect its grade but are often considered necessary to identify its type in any of the grades. These are *texture* and *length.*

The *texture* of a fiber, in most cases, varies according to its cleaning. This will, therefore, be designated as "Soft," "Medium," or "Hard," accordingly, as the cleaning is "excellent," "good," "fair," or "coarse." Some varieties of abaca in North and South Mindanao produce a fiber which is naturally of medium or hard texture, though it may be of excellent cleaning.

Under *length,* abaca fiber shall be designated "very long," when it exceeds 3 meters (10 feet); "long," when it is 2½ to 3 meters (8 to 10 feet); "normal," when it is 1½ to 2½ meters (5 to 8 feet); and "short," when it is under 1½ meters (5 feet).

Maguey and sisal will be designed "long," when 1 meter (40 inches) or more in length; "normal," when between 60 centimeters and 1 meter (24 to 40 inches); "short," when between 50 and 60 centimeters (20 to 24 inches); and "very short," when under 50 centimeters (20 inches).

ARTICLE III.—*Baling, labeling, and inspection*

The following additional regulations regarding baling, labeling, and inspection of bales shall be complied with by all grading establishments:

SECTION 1. Each hank in a bale of fiber for cordage purposes shall not exceed 12, nor be less than 6 centimeters in diameter before pressing, but in a bale for tagal braid each hank may be less than 6 centimeters.

Every bale of fiber shall be free from strings, waste, tow, damaged fiber, fiber not identical with that which constitutes the bale, or any extraneous matter, and the fiber shall be thoroughly dry.

All hanks of fiber in a bale shall be uniform in quality and each hank shall also be securely tied by a strand to hold the fibers together and which shall be identical with the fiber which constitutes the bale. The manner of tying the hank without forming a knot and the size of the strand to be used are illustrated in the standard samples. Neither end of the strand should be knotted.

SEC. 2. The dimensions of each bale of the grades "Tagal-one" to "Tagal-five" inclusive, may be increased not more than 40 per cent over the measurements prescribed in section 1783 of the Administrative Code (Act No. 2711).

SEC. 3. The division of each hank into two or three parts, and the twisting of these parts in a manner similar to the twisting of the strands of a rope, is prohibited. The hank may, however, be twisted once or twice as a whole sufficiently to keep the fibers together.

SEC. 4. The hanks shall be laid straight in the bale, the heads (butt ends) in one row alternating with the tips (points) of the next row. The hanks shall not be doubled upon themselves more than is absolutely necessary.

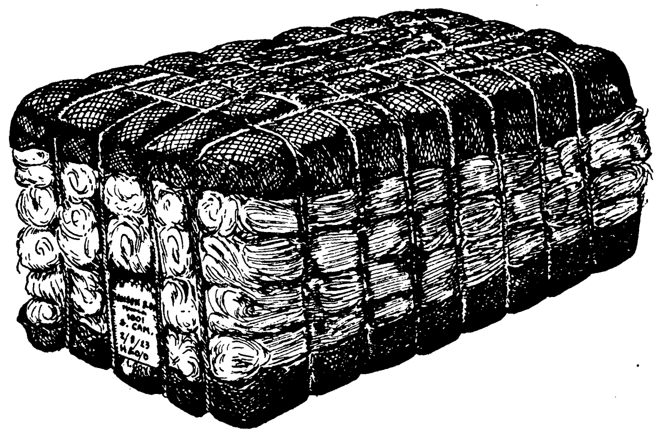


FIG. 1. The completed bale showing method of wrapping, binding, and tagging

SEC. 5. Each bale of fiber shall be securely bound with not more than eight side and four end bands, made of the same kind of fiber as that contained in the bale, or of bejuco (rattan). The outer bands shall not be nearer than 10 centimeters to the edge. (*See* figure 1.)

SEC. 6. All fiber on being graded shall be divided into lots. The fiber in each lot shall be of uniform type, but may be of more than one grade. The lots must be numbered consecutively, and a range of numbers will be furnished each grading establishment along with the grading permits, which numbers may be repeated as soon as exhausted. The inspection of a shipment of fiber shall be made on each lot separately, and a separate certificate of inspection given for each lot inspected. A lot of fiber shall be considered under inspection until all the bales of

all the grades included in it shall have been stamped and the required certificate of inspection issued therefor.

In order to avoid unnecessary confusion and to obtain uniformity in type, the attention of the graders is called to the necessity of dividing their lots in such a way as to have in one lot fiber which comes from one district or province only. Otherwise, any readjustment of lots may entail unnecessary trouble and expense to the grader.

In order to facilitate the division of fiber into lots uniform in type, the abaca producing provinces of the Philippine Islands shall be divided into the following districts, the product of each of which may be considered by the grader as uniform and may be included in one lot:

Province or island	District	Abbreviation
Albay	Albay	Albay.
Catanduanes	Catanduanes	Catanduanes.
Leyte	East Leyte	E. Ley.
	West Leyte	W. Ley.
Mindanao Island	North Mindanao	N. Min.
	South Mindanao	S. Min.
North Camarines	North Camarines	N. Cam.
Samar	North Samar	N. Sam.
	South Samar	S. Sam.
Sorsogon	North Sorsogon	N. Sor.
	South Sorsogon	S. Sor.
South Camarines	South Camarines	S. Cam.

The remaining abaca-producing provinces shall each be considered a separate district by itself.

In order to facilitate the identification of the baling establishment where a bale or bales of fiber in a lot were pressed, the following grading stations will be known by the following permanent initials which shall be placed before the pressmark separated by a bar:

Albay	Guinobatan	GN
	Legaspi	L
	Ligao	LI
	Tabaco	T
Catanduanes	Virac	VC
Cebu	Cebu	C
Davao	Davao	DA
	Daliaon	DL
	Malita	ML
	Mati	MI
	Santa Cruz	SC
	Talomo	TO
Iloilo	Iloilo	I
Ilocos Sur	Vigan	V
Leyte	Baybay	B
	Carigara	CR
Leyte	Maasin	MA
	Malitbog	MG
	Palompon	P
	Tacloban	TL
Manila	Manila	M
Masbate	Masbate	MS
Misamis	Cagayan	K
N. Camarines	Daet	D
S. Camarines	Iriga	IR
	Lagonoy Dis.	LA
	Naga	N
	Nato	NT
Samar	Borongan	BO
	Calbayog	CA
	Catarman	CM
	Catbalogan	CT

Samar	Laoang	LM	Sorsogon	Matnog	MT
Sorsogon	Bulan	BU		Sorsogon	S
	Casiguran	CS	Surigao	Surigao	SU
	Donsol	DS	Tayabas	Mauban	MU
	Gubat	G	Zamboanga	Zamboanga	Z

SEC. 7. Each bale of fiber shall bear a tag of white, unstarched, cotton cloth not less than 75 centimeters long nor less than 10 centimeters wide. One end of this tag shall be placed at or near the middle of the bale, while the other end shall project about 12 centimeters beyond the end of the bale, and shall be clearly visible. (See fig. 1.) The end of the tag inside the bale shall be tied to one of the hanks in the middle of the bale and just below the tie shall bear the full or abbreviated name of the grading establishment, the name of the station, the number of the lot, the full or abbreviated name of the province or district of production, and the date of pressing. (*See* fig. 2, *a*, *b*, *c*, *d*, *e*.) The letter-designation of the grade should not appear on the end of the tag inside the bale. The end projecting beyond the bale shall be divided into two sections, the section adjacent to the bale shall bear the same data as are stamped on the end inside the bale, including the date of pressing, while the outer section shall bear the abbreviated name of the grading station accompanied by the pressmark and the official letter-designation of the grade, the three separated by bars, but forming one mark and, below this, the Government stamp giving the official name of the fiber and the official letter-designation of the grade. (*See* fig. 2, *a′*, *b′*, *c′*, *d′*, *e′*, *f*, *g*.)

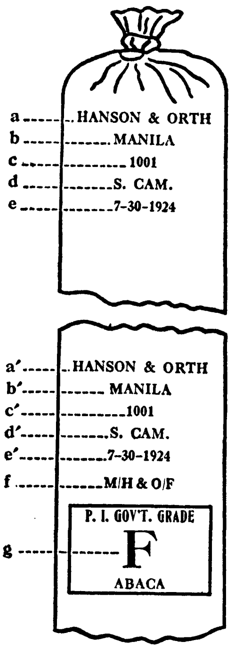


FIG. 2. Cloth tag showing (*a*,*a′*) name of grading establishment; (*b*,*b′*) name of station; (*c*,*c′*) lot number; (*d*,*d′*) district of production; (*e*,*e′*) date of pressing; (*f*) abbreviated name of grading station, press mark and letter designation of the grade, all forming one mark; and (*g*) Government stamp.

The letters and numerals stamped on the cloth tag mentioned in this section shall not be less than 1 centimeter in height.

On the mats covering the two surfaces of the bale shall be stamped or stenciled in clear indelible ink the abbre-

viated name of the grading station accompanied by the pressmark and the official letter-designation of the grade.

ARTICLE IV.—*Cancellation of previous Administrative Order*

Administrative Order No. 25, dated February 8, 1923, and approved by the Secretary of Agriculture and Natural Resources on April 2, 1923, is hereby repealed.

This order shall take effect six months from the date of its approval by the Secretary of Agriculture and Natural Resources.

ADN. HERNANDEZ
Director of Agriculture

Approved, August 1, 1924:

SILVERIO APOSTOL
Acting Secretary of Agriculture and Natural Resources

The Philippine Agricultural Review

VOL. XVII FOURTH QUARTER, 1924 No. 4

A QUARTERLY PUBLICATION

ISSUED IN ENGLISH BY THE
BUREAU OF AGRICULTURE

The Government of the Philippine Islands
Department of Agriculture and Natural Resources

Subscription rates: ₱2 (Philippine currency) or $1 (U. S. currency) per annum in the Philippine Islands and the United States and territories.
$2 (U. S. currency) per annum in foreign countries.

MANILA
BUREAU OF PRINTING
1924

(Entered at the Post Office at Manila as second-class matter)

THE PHILIPPINE

Agricultural Review

VOL. XVII | FOURTH QUARTER, 1924 | No. 4

TABLE OF CONTENTS

	Page
1. The Raising of Wrapper Tobacco in the Cotabato Valley, by Mariano E. Gutierrez	227
2. A Preliminary Report on the Effect of Distances of Planting Wrapper Tobacco, by Domingo Paguirigan and Nemesio Hernandez	237
3. Coöperative Marketing as a Factor in Improving Our Agricultural Conditions, by Jose S. Camus	245
4. Progress Report on Five New Hybrid Varieties of Tobacco, by Mariano E. Gutierrez	253
5. Progress Report on Adlay, by P. J. Wester	261
6. The Past and Present Work of La Carlota Experiment Station, by Silvestre Asuncion	267
7. The Tanauan Citrus Station and Its Work, by Jose de Leon	279
8. A Descriptive List of Mango Varieties in India: An Addenda, by P. J. Wester	283
9. Quarterly Notes	293
10. Index to Vol XVII, 1924	295

Supplement (re Adriano Hernandez) bound at end of volume.

LIST OF ILLUSTRATIONS

Facing page—

PLATE I. (*a*) Baker's Sumatra 254
(*b*) Florida-Sumatra, the result of three generations of breeding........ 254
II. (*a*) Plant-to-the-row test with the Baker's Sumatra X Florida-Sumatra (Ax-hybrid) 254
(*b*) Shapes of leaves of the different strains of Baker's Sumatra X Florida-Sumatra 254
III. (*a*) Plant of the Ax—hybrid........ 256
(*b*) Plant of the Bx—hybrid........ 256
IV. Shapes of leaves of the different strains of the Florida-Sumatra X Baker's Sumatra 258
V. (*a*) Plant-to-the-row test with Florida Sumatra X Baker's Sumatra (Bx—hybrid) 258
(*b*) Plant-to-the-row test with Dammao Broadleaf X Baker's Sumatra (Damatra) 258
VI. Plant-to-the-row test with Havana X Baker's Sumatra ("Havamatra").... 260
VII. Adlay ready for the harvest. Lamao Experiment Station........ 262
VIII. A plate of adlay biscuits, made of equal parts of whole-adlay and wheat flour 264
IX. (*a*) A view of a portion of the citrus orchard, Tanauan, Batangas........ 280
(*b*) Citrus nursery, Tanauan, Batangas........ 280
X. (*a*) Exterior view of the storage chamber........ 280
(*b*) View of the interior part of the chamber........ 280

TEXT FIGURE

FIG. 1. Sketch showing arrangement of lots and divisional plots........ 240

THE RAISING OF WRAPPER TOBACCO IN THE COTABATO VALLEY, MINDANAO

By MARIANO E. GUTIERREZ
Superintendent, Pikit Tobacco Station

Certain regions of the Cotabato Valley, Cotabato Province, and the high regions surrounding the valley are well adapted for thè growth and production of different classes of leaf tobacco, especially wrapper tobacco. This statement is based upon the results obtained for several years at the Pikit Tobacco Station of the Philippine Bureau of Agriculture.

The soil and the climatic conditions, which are highly favorable, make these regions of the valley good fields for the production of wrapper tobacco on a big scale.

CLIMATE

There are some variations of rainfall in the different portions of the valley due to altitudes and the condition of vegetation. Rainfall is generally greater in the high regions with mountain ranges nearby and at the lower portions of the valley than the central portion, which is mostly covered with grasses for big areas. The two tables below show the average rainfall for several years in Cotabato town, in the lower valley, and the rainfall for 1922 at Pikit in the central part of the valley.

TABLE 1.—*Mean amount of rainfall at Cotabato town*

Month	Mean in millimeter	Mean number of rainy days
January	98.8	12.6
February	88.8	10.1
March	68.1	7.8
April	164.9	12.7
May	218.5	14.7
June	237.3	17.2
July	292.0	18.4
August	271.2	18.4
September	248.6	16.7
October	255.1	15.3
November	231.7	15.9
December	133.5	13.0

Total mean amount of rainfall .... 2,309.1 mm.
Total mean number of rainy days 172.8
Average monthly rainfall .... 192.3 mm.

TABLE 2.—*Monthly rainfall at Pikit, in 1922*

Month	Mean in millimeter	Number of rainy days
January	119.5	19
February	68.3	7
March	217.8	14
April	275.5	10
May	287.7	18
June	213.4	18
July	145.1	18
August	91.7	11
September	66.3	10
October	263.8	17
November	182.2	15
December	60.6	15

Total amount of rainfall 1,631.5 mm.
Average monthly rainfall 135.9 mm.
Total number of rainy days 172

The rainfall in Pikit and in general in the Cotabato Valley varies in the monthly totals; the same month in two different years may have some variations in the total amount. The climate sometimes becomes erratic. Under normal conditions, however, the rainfall may be distributed as follows:

Heaviest.—May, June, July, September, and October.
Medium.—April, August, November, and December.
Lightest.—January, February, and March.

Temperature.—The temperature in the Cotabato Valley averages 26°C. during the year. The maximum temperature rarely reaches 35°C. and the minimum 20°C. In the morning and evening the temperature is pleasant, it is rather warm at noon till 3.30 p. m., when there is no rain.

The Cotabato Valley is out of the typhoon belt and is therefore free from destructive storms. There are some strong winds, generally preceding heavy rains, but not of sufficient strength to damage standing crops.

The range of relative humidity is small.

CLIMATIC CONDITIONS IN SUMATRA AND THE COTABATO VALLEY

The climatic conditions of the Cotabato Valley are similar in many respects to those of the Island of Sumatra. This similarity of climate, more than any other factor, may explain the high suitability of the Cotabato Valley for the production of tobacco wrapper. The following table shows more or less the parallel conditions prevailing in both places:

	Sumatra	Cotabato valley
Average temperature	27°C.	27°C.
Maximum temperature	33°C.	33°C.
Minimum temperature	21°C.	21°C.
Rainfall	80–120 inches.	60–100 inches.
Distribution	Rather even.	Rather even.
Atmospheric condition	Humid	Humid.
Strong storms	None	None.
Time of rainfall	Mostly at p. m.	Mostly at p. m.

The Deli District situated in the northwestern part of Sumatra, where most of the plantations producing the best wrapper are located, and Cotabato Province are both north of the equator, but Cotabato is farther north by a few degrees

SOIL

Speaking of the requirements of the tobacco plant, which is very sensitive to these conditions there are different regions or zones due to the different conditions existing in the valley. While as a general proposition the soil formation of the valley is uniform, yet there are different soil conditions with reference to the soil and subsoil, generally known as the root zones of short season crops. This is of fundamental importance to the tobacco grower. Before describing in detail the type to which the soil of the valley belongs, a rough classification may be given as follows:

1. Regions that are very black and oftentimes soggy, due to the abundance of humus and low conditions. These regions may be found in the lower valley, near swamps, near the Rio Grande de Mindanao below Fort Pikit. These regions are subject to the overflow of the river and generally support talahib and other large grasses and plants that thrive in low soils. These low black bottom lands can, of course, grow fine tobacco, but due to the color of the soil, it will not produce a preponderance of light colored leaf. Moreover, the field operations in these lands are quite expensive.

2. Regions that are higher than the first class, being located in the upper reaches along the Rio Grande and its tributaries and close to the rolling country near some mountain ranges. The soil of these regions are inclined to be of light color. These lands support mostly cogon and other small grasses and second growth and virgin forests. These lands are of immediate interest to the tobacco planter.

3. Small patches of very sandy soil near the rivers. The sand may have been deposited during recent floods. Since these lands are of small areas and are generally found in the regions in the first classification, they are only of interest to the small growers.

4. Rolling country and slopes of large mountain ranges. Strictly speaking, this country does not belong to the valley, but also fine tobacco can be grown. This should be so on account of the excellent drainage, the great distance from the sea and the constituents of the soil.

Lands under the second classification are especially recommended for the growing of wrapper tobacco. It is under this

class that the following regions belong: Bual–Libuñgan section, Maridagao Valley, certain parts of the Cabacan District, part of the Banisilan region, the northern half of the Sarangani Plain, and other lesser regions of the valley that are not flooded. These lands are fairly well drained.

Lands under the fourth classification are excellent for tobacco but they are very far from the routes for the cheap transportation of the produce.

The soil in the valley is the typical alluvium of great fertility and depth. The surface soil, varying from 30 cm. to 60 cm. is a rich loamy soil with a large percentage of humus. The color is from light to deep brown.

The soil and the subsoil are free of course sand and stones of any kind. These are of uniform and even texture. The soil is very porous and friable. It does not retain water for a long time due to the absence of rocky stratum beneath the subsoil.

SOIL CULTIVATION

The preparation of the land for any crop in the valley varies as the vegetation of the land differs. With land supporting large grasses it is necessary that the natives with their long bolos cut these grasses and allow them to dry thoroughly including the large stems, and then burn before plowing, whether by tractor or animal power. Two plowings, one disk-harrowing and two harrowings will bring the soil of these lands into excellent tilth for tobacco. An interval of time should be allowed to elapse between plowings in order to dry out the exposed large roots, otherwise when covered in their fresh state they will soon shoot up again.

Lands supporting mostly small grasses, like cogon and allied forms (prairie grass) are ready for the tractor without the necessity of cutting. Occasional fire resistant trees growing among the cogon should be felled and stumped, so that they will not interfere with the plowing operations. With animal power, the cogon should be first rolled over, allowed to dry for some days and then burned and immediately after, plowing can be started. Two plowings and two harrowings will bring this kind of land into good condition for cropping.

With second growth and virgin forest lands, it is necessary to remove the underbush, and after being dried, should be burned. The small and large trees should be felled. If the land is needed immediately for cropping, it should be necessary to remove the stumps and these gathered and burned. As for the disposition of the logs, it is left to the manager of the plantation to decide

whether it is more expedient for him to reduce them to ashes or should be gathered for the purposes of the plantation. Depending upon the thoroughness of clearing, this class of land can be brought into excellent condition for tobacco by one or two plowings and similar number of harrowings. Generally, these lands are less weedy that the other kinds described. These lands should be preferred for tobacco.

CROPS

Tobacco culture in the Cotabato Valley is in its infancy. Only isolated small cultures are in evidence in the different regions just to supply local demand. This should not be surprising as the Cotabato Province is just in the beginning of its development. The land brought under cultivation is very small, and extensive tracts of thousands and thousands of hectares lie uncultivated, awaiting enterprising people and capital to bring them into production.

The cogon lands and those with second growth forests have been generally covered with virgin forests in the past, but are now covered with their present vegetation due to one or two croppings made by natives, and also to occasional fires. These lands have been abandoned for quite a long time. Some of these lands have been laying fallow from 5 to 150 years.

Cogon lands can be brought back to produce excellent crops in one year by deep plowing, killing all the cogon, followed by planting some leguminous crop, if possible, to be plowed under. After thorough preparation they can be planted to other crops, but the first harvest will not be very good. With lands covered with tall grasses, like talahib, they can produce at once excellent crops of tobacco without the necessity of soil renovation. The lands covered with second growth and virgin forests are in their virgin state for tobacco. These lands are superior to the others for tobacco.

SOIL CONSTITUENTS

Evidently the soil of the valley contains ammonia, phosphorus, and potash in varying amounts: NH_3 from .08 per cent to .19 per cent; P_2O_5 from .13 per cent to .18 per cent; and K_2O from .42 per cent to 1.14 per cent. The wide range of crops grown in the valley with excellent harvests point conclusively that the necessary mineral foods for the proper development of the crops must be present. The dark green foliage of most cultivated crops, the bountiful harvest, and the very white ash of the tobacco produced are good practical clues that these constituents must be present in sufficient quantities, as certain lands

in the valley have been known to be croppéd, with corn and rice for example, continuously for 10 years, without a very noticeable decrease in production. Aside of natural fertility, this condition, may be due, in part to occasional floods.

FERTILIZERS

So far no fertilizer of any kind has been used for tobacco due to the great fertility of the land.

TIME OF PLANTING

Generally in the Cotabato Valley, the seed of the tobacco is sown in seedbeds in the beginning of October. The seedlings are transplanted after the middle of November. Harvesting by priming the leaves is started about the end of December and continued up to March.

HANDLING OF THE CROP

As there is no organized industry on tobacco growing on commercial proportions in the valley, the handling of the tobacco crop is primitive. Moreover, the tobacco grown is for local consumption only, generally for chewing, and it would be useless to describe the methods in growing this kind of tobacco.

The Pikit Tobacco Station of the Bureau of Agriculture, at Pikit, is the only place in the valley where tobacco is grown on a larger scale than any of the present native cultures. Brief descriptions of the methods used at the station will be given. This station handles mostly wrapper tobacco.

Seed beds.—A fertile high land is thoroughly prepared for seedbeds. The beds are made 1 meter wide by 8 meters long, running east to west. For sterilization, the soil is pan roasted. Slightly inclined framework covered with woven nipa, cogon, or other grasses are used for covering the beds. The seeds are rather thinly or thickly sown, depending whether the small seedlings will be allowed to develop in the beds, or are to be pricked into fresh beds of similar size. The seedlings are allowed to receive increasing light in the beds by removal of the cover. Ten days before transplanting the covers of the beds are entirely removed to accustom the seedlings to field conditions.

Generally, the station pricks the small seedlings to fresh beds. When the seedlings that have been thickly sown are from 15 to 25 days from sowing, they are drawn from the seedbed and are planted about 7 centimeters apart each way in new beds by women and children. These beds need not have the soil sterilized. These pricking beds are covered with slats, talahib stems

woven with bejuco, resting on level framework of bamboo. The covers admit half light and can be rolled at will, if it would be necessary to give full sunlight and during the watering of the seedlings by sprinklers.

Transplanting.—When the seedlings are from 45 to 50 days from the date of sowing, they are transplanted into the field that have been previously thoroughly prepared. Before removing the seedlings, the beds are thoroughly watered, and they are carefully removed by trowels or sharpened sticks with a bell of earth around the roots of each seedling. These seedlings are carried into the field in shallow boxes.

Planting distances.—The station grows four Sumatra strains, the Florida-Sumatra, and five hybrids varieties. The spacings found best adopted for Sumatra is 80 centimeters between the rows and 40 centimeters between the plants in the row. With Florida-Sumatra, having larger leaves than the Sumatra, the spacing between the rows is from 90 to 100 centimeters and 50 centimeters between the plants.

The furrows are laid in two ways: (1) By wooden markers. When the ground is dry at transplanting time, this method is availed of. Holes are dug for the young plants; a tumbler of water is poured into each hole before setting the plant. (2) By light plows. This is resorted to when the ground is wet or when it is raining, and there is no need of watering. With the plow furrows are opened just before transplanting, in order to prevent the evaporation of the necessary moisture for the young plants. This is a very rapid and cheap way of transplanting.

Cultivation.—The tobacco field should be absolutely clean of weeds and in the best of tilth during the development of the plants. Cultivation is started as soon as the plants get well established and is frequently repeated until it is no longer possible to do so on account of the large size of the plants which interfere with the operation. Ridging the rows at the station is done by means of cultivators. The soil between the rows is first stirred with cultivators having small teeth. This is followed by another cultivator with large shovel-like side teeth. This series of cultivations is repeated three times, and the large teeth at the sides of the second cultivator gradually ridge the rows, so that in the end the rows stand on fairly high ridges. The ridges protect the plants from excessive rains and provide larger feeding area for the roots.

Topping and suckering.—As a rule the plants of the station are topped. The flower heads are allowed to develop before they

are completely removed. This topping is not done to include some of the top leaves. After topping the plants produce axiliary shoots and suckers. These are completely removed by pinching with the fingers.

Picking worms.—In the seedbeds worms appear to destroy the leaves. At the station the worms are removed by women or sometimes the plants are sprayed with 1 per cent solution of arsenate of lead.

In the field the picking of worms is invariably done by women early in the morning and late in the afternoon, when the worms are actively eating the leaves.

Harvest.—Harvest of the leaves is always done by priming; i. e. by removing the leaves as they ripen. Early in the morning the leaves are wet with dew and on account of this condition harvest are always carried out late in the morning or beginning at 1 p. m. Ripe leaves can be recognized by a noticeable change of color to lighter green, by yellow specks at the tips and other parts, and by swollen and rough appearance. For wrapper tobacco the leaves should be picked before they become very mature. This is important. The harvest leaves should be always protected from unnecessary exposure to the hot sun.

Curing.—The leaves are carried in baskets to the curing shed, 14 meters long, 7 meters wide and 4 meters to the eaves, and with swinging walls of *salangui*. The leaves are arranged perpendicularly with tips up on the floor of the shed with *salangui* spread on the ground, in order not to have the leaves touch the ground. The next day when the leaves are sufficiently wilted for handling, they are strung by means of gunny sack needles and twine or fibers of *bago*. Two ways are practised in stringing the leaves: (1) The leaves are strung through the petioles and arranged in such a way that the midribs are exposed on both sides and the leaf blades are turned in. The leaves are made to ride alternately on poles 2.5 meters long. (2) The petioles are pierced by the needle, so that the leaves are face to face and back to back. With this method of stringing, the poles used are about 1½ meters long. The two ends of the string or twine are securely tied at the two ends of the pole, so that the strung leaves just hang and are not made to ride on the pole as the first method. The sagging of the string due to the heavy weight of green leaves can be prevented by tying the string at intermediate points at the pole. The second method is generally used in Sumatra and Cuba.

The swinging walls of the shed are managed in order to admit or exclude, as the leaves in process of curing require, the neces-

sary light, air, and moisture for slow curing, in order to fix in the leaves the desired color and quality. The management of the curing shed requires experience and it is needless to give set rules. The leaves are considered cured when the midribs are thoroughly dry, necessitating for this process from 18 to 25 days.

The cured leaves are detached from the poles, are brought closer together in the middle of the string, both ends of which are tied, making a loose bundle. The removal of the leaves from the poles is always done in the morning when the leaves have sufficient moisture acquired during the previous evening. The cured leaves are brought to the bodega for fermentation.

Fermentation.—The cured tobacco is piled in small bulks at first, in the case of the station a bulk may represent the harvest from one experiment. The temperature of these small *mandalas* is allowed to reach 38°C. when they should be rebuilt, in order to give even fermentation of the inside and outside bunches. These small *mandalas* are combined to make up one large *mandala,* 3 meters long by 2 meters wide and 1½ meters high. The mandala could be increased in its dimensions to advantage, but the yearly harvest of from 2,000 to 3,000 kilos of the station is not of sufficient quantity to make a larger mandala.

The large mandala should be built carefully so that it will have even dimensions at the top and at the bottom. The bunches of leaves are so arranged that the tips are inside and the petioles pointing outward. The *manos* should be arranged in even layers from outside to the center. In order to have the leaves touch each other, heavy boards are placed periodically on top of the mandala.

A bamboo tube, with slits and the divisions removed, is placed horizontally in the middle of the mandala with the end out for inserting a thermometer, which is the only guide for this important process. The end of the bamboo where the thermometer is inserted should be corked or covered, so that the air in the tube should have the same temperature as that of the mandala.

The whole pile of tobacco should be covered with mats or canvass.

The thermometer should be read twice or thrice a day, depending upon the rise of the temperature. The readings should be recorded in a card tied to the mandala.

The temperature should rise gradually and when it reaches 42°C. the mandala is rebuilt and the hands shaken out. At the rebuilding of the pile the bunches of the leaves that were inside are placed outside and vice versa. The pile is rebuilt several

times, each mandala giving a rise of 4 degrees over the temperature of the previous one, that is, at 46°C., 50°C., and the last rebuilt mandala should reach 53°C. For practical purposes 53 degrees temperature is enough. Sometimes the condition of some tobacco requires a higher temperature in order to complete the fermentation, but for wrapper it should never exceed 55°C.

Fermentation may require from 3 weeks to one month.

Sorting.—After fermentation the leaves are sorted into four classes: (1) wrappers, (2) binders, (3) fillers, and (4) inferior (trash). The wrappers are classified further according to three principal colors: claro, colorado claro, and colorado. These grades are also separated into class sizes as required by Internal Revenue regulations. The binders and fillers are also separated into class sizes.

SUMMARY

From the above description, the following very necessary requisites for successful wrapper production, with right conditions of climate and soil assumed, may be briefly stated:

1. A very rapid uninterrupted growth of the plants.
2. Uniform stand of crop in the field in order to provide the necessary intershading of the leaves.
3. Planting at close distances for the production of fine leaves. Fineness rather than size is the prime consideration.
4. Absence of spots or specks caused by diseases and destruction caused by worms and insects. Wrapper leaves should be sound and whole.
5. Proper curing, and controlled fermentation by the thermometer.
6. Proper classification of leaves into classes and grade.
7. The conscientious attention to all details incident to production.

A PRELIMINARY REPORT ON THE EFFECT OF DISTANCES OF PLANTING WRAPPER TOBACCO

By DOMINGO B. PAGUIRIGAN
Assistant Agronomist, in Charge of Tobacco Investigations

AND

NEMESIO HERNANDEZ
Agricultural Assistant

GENERAL CONSIDERATIONS

One of the main reasons which prompted the Government to establish a tobacco experiment station at Isabela Province in 1916, was to undertake wrapper tests in an attempt to check if possible the ever-increasing importation into the Islands of wrappers from the Dutch East Indies and the United States. The undertaking naturally fell under the following five lines of activities:

1. Acclimatization of recognized strains, e. g., Florida-Sumatra and Havanensis.
2. Selection of desirable strains from the heterogenous local stocks.
3. Hybridization to get desirable combinations either among the native strains or between native and foreign strains.
4. Consistent cultural methods, e. g., shorter spacing, partial artificial shading, early harvesting, etc.
5. Methods of curing tobacco.

The results obtained until the year 1920, have been rather so irregular, that is, while the technique followed has been as uniform as possible, no two seasons ever furnished the same results. It was this fact that prompted the Bureau of Agriculture to realize that perhaps the climatic conditions must have a considerable influence on the culture as have been asserted to and conclusively demonstrated by leading authorities with respect to tobacco in particular. Whitney of the United States Department of Agriculture concluded thus, "The plant is far more sensitive to these meteorological conditions than are our instruments." Obviously climatic and soil conditions jointly and primarily determine whether a locality or region is suitable for the raising of wrapper tobacco. But irregular results were obtained at the Dammao Tobacco Station in Isabela Province during the first five years of its existence notwith-

standing the fact that in the station are some choice rich sandy alluvial soils. Hence, the only important factor which remained questionable was that of climate.

If we should consider the climate of Sumatra as the standard for wrapper tobacco production, by comparing the climates of Isabela and Cotabato respectively with it, we would find that there is a remarkable similarity between the climates of Sumatra and Cotabato, whereas that of Isabela is so different. (See Table I.)

TABLE I.—*Records of temperature and rainfall of some tobacco regions*

Regions	Isabela	Cotabato	Sumatra
Temperature:	°*C.*	°*C.*	°*C.*
Means of annual minimum	15.2	20	21
Means of annual normal	26.7	26	27
Means of annual maximum	38.9	35	33
Annual range	5.5	1.4	(Very uniform)
Rainfall:	*mm.*	*mm.*	*mm.*
Mean of annual rainfall	1,683.0	2,272.1	2,540.0

Another climatic advantage of Cotabato over Isabela is that it is virtually outside of the typhoon belt. The records of the Weather Bureau show that during the period of 1903 to 1918, the percentage of remarkable typhoons for Cotabato was 0; Isabela, 21.5 and Cagayan, 35.0.

In view of the above considerations together with the alluvial well-drained soils which abound in the Cotabato Valley, the Bureau of Agriculture took the only logical step by establishing in 1920 in this region, a tobacco experiment station at Pikit, to coöperate with the Dammao Tobacco Station. That this step is justified although the station has only been under operation during three years, is evident from encouraging testimonials received from some of the leading Manila cigar manufacturers regarding the qualities of wrapper samples produced in Cotabato and submitted to them.

MOST SUCCESSFUL WRAPPER TEST IN COTABATO

Because of the considerable young existence of the Pikit Tobacco Station, the results that can be presented, are naturally from cultures of already definitely established or pedigreed strains or varieties whose purity has been maintained at the station by rigid in breeding, generation after generation. Thus, the test that so far has given the most satisfactory results along the production of wrappers, is the acclimatization of the foreign varieties, 14 Baker's Sumatra and 1 Sumatra-Florida planted in suitable close distance. And for the benefit of those

planters who are particularly interested in the Philippine cigar tobacco industry, the results obtained during the season of 1922–1923, are being presented in this paper in the form of a preliminary report.

CHARACTERISTIC FEATURES OF THE VARIETIES USED

There is no marked morphological difference between the 14 Baker's Sumatra and the 1 Florida–Sumatra except that the latter seems to be more prolific. Consequently, both may be considered as strains or subvarieties only of the characteristic variety, Sumatra. The chief characteristics of this variety are its round-pointed, erect leaves with a very high breadth index which is generally between 50 and 60 per centum. The number of leaves averages from 26 to 28. The average height is about 6 feet when grown in the open at closer distances. All things being equal, this variety produces the greatest percentage of wrappers.

14 Baker's Sumatra was introduced into the station as first acclimatized at the Dammao Tobacco Station, Isabela, by Dean C. F. Baker of the College of Agriculture, Los Baños and Florida–Sumatra, by the Bureau of Agriculture, Manila.

PLAN OF CULTURES

A field was selected which was as uniform as possible with regard to topography and physical characteristics. It was equally divided into two parts in order that the culture for each strain should be an exact duplicate of the other. (See text figure No. 1.) Each part was divided in turn into five plots which were numbered consecutively from 1 to 5 for the 14Baker's Sumatra lot or Lot No. 1 and from 6 to 10 for the 1Florida-Sumatra lot or Lot No. 2. The areas of the plots were as follows:

Plots	Square meters
1 and 6	588.00
2 and 7	579.00
3 and 8	560.00
4 and 9	509.60
5 and 10	1,102.10

The distance between the rows for each pair of plots were made thus:

Plots	Centimeters
1 and 6	100
2 and 7	90
3 and 8	80
4 and 9	70
5 and 10	80

With the exception of Plots 5 and 10 in which the plants were set out 40 centimeters apart in the rows, in every plot, the distance between the plants in the rows was uniformly 50 centimeters.

As may be seen from the above spacing the five distance combinations used in the experiment were 100 x 50, 90 x 50, 80 x 50, 70 x 50, and 80 x 40 centimeters, respectively.

14 BAKER'S SUMATRA LOT OR LOT No. 1

PLOT 1 100×50 cm.	PLOT 2 90×50 cm.	PLOT 3 80×50 cm.	PLOT 4 70×50 cm.	PLOT 5 80×40 cm.

PATH 2 METERS WIDE

PLOT 6 100×50 cm.	PLOT 7 90×50 cm.	PLOT 8 80×50 cm.	PLOT 9 70×50 cm.	PLOT 10 80×40 cm.

1 FLORIDA-SUMATRA LOT OR LOT No. 2

FIG. 1. Sketch of field showing arrangement of lots and divisional plots and the strains of commercial tobacco planted and distance combinations.

FIELD SUMMARY OF OPERATIONS AND CURING AND FERMENTING PROCESSES CONDUCTED

Transplanting was done in November, 1922, a little over two months after sowing. As at Dammao, the newly-transplanted seedlings were protected from the hot sun with coverings of convenient banana sheath cuts. The young plants were first mulched by loosening the soil around them with trowels. The field was cultivated actually only once. Suckering was rigidly observed but topping was dispensed with in order to insure greater inter-shading of the plants and also to determine the maximum development attained by the plants in different distances of planting. Harvesting was carried on only by priming and the leaves harvested were poled Cuban-fashion, being

strung with the fiber of a malvaceous shrub locally called "bago-bago." Curing was allowed to take place wholly in the shed or barn and the cured leaves were subjected to the ordinary, simple bulk fermentation.

EFFECT OF DISTANCES ON THE CROP AS A WHOLE

Physiological considerations.—Obviously the effect of close planting is to reduce the activity of photosynthesis as in the use of chees-cloth tents, in order that the leaves in the first place, may not develop thick in texture as the result of the relative reduction of the supply of carbohydrates. Indeed, it is not presumed in this connection that the effect of the shade furnished by the cheese-cloth tent is the same as that which is the result of close planting because, in the first place the intensity of light is not so well regulated in the latter. But one this is common between the two. And that is, the considerable reduction of the amount of light actually received by the leaves, which, while it is true for all the leaves of plants in the tent, it is only effective for the lower leaves of plants grown in the open, no matter how closely they are set out in the fields. The problem of the tent user consists only in the right mesh of cloth but the open grower must determine the spacings and the choice of the right strain or strains.

Other physiological phenomena observed in connection with the effect of shading on the tobacco plant in particular are those with respect to absorption and transpiration. Stutzer and Goy(1914) observed that tobacco grown under controlled conditions produced a large percentage of nicotine and high potassium but low chlorin content as the result of abundant sunlight, liberal nitrogeneous manuring, and sparing use of water in the soil. Hasselbring(1915) while connected with the Cuban Experiment Station in the winter of 1908, observed that tobacco plants grown in the open absorbed about 30 per centum more water than those grown under shade. The plants which absorbed and transpired the greater quantity of water contained the smaller percentage and the smaller absolute quantity of ash. It appears from these observations that the absorption of salts by roots is independent of the absorption of water and that the transpiration stream does not exert an accelarating effect on the entrance of salts.

Effect of distances on the development of the leaves.—Observations on the development of the leaves were grossly made and are presented below in tabular form (Table II).

TABLE II.—*Effect of different distances of planting on the development of the leaves*

Distance combinations	Strains	Gross effect on the development of the leaves
100×50 centimeters	14 Baker's Sumatra	Coarse, thick, gummy, and dark.
	1 Florida-Sumatra	Do
90×50 centimeters	14 Baker's Sumatra	Do.
	1Florida-Sumatra	Do.
80×50 centimeters	14 Baker's Sumatra	Smooth, thin, less gummy, and light.
	1 Florida-Sumatra	Development as a whole, poor.
70×50 centimeters	14 Baker's Sumatra	Do.
	1 Florida-Sumatra	Do.
80×40 centimeters	14 Baker's Sumatra	Smooth, thin, less gummy, and light.
	1 Florida-Sumatra	Development as a whole, poor.

The classification of the sound leaves into wrappers and fillers was based on prevailing market standards irrespective of size. All leaves of uniform color, small veined, fine textured, elastic and pliable were considered wrappers. The rest of the leaves that were not fine textured enough but of good aroma and burn were considered fillers.

The following table shows the actual yield in fillers and wrappers.

TABLE III.—*Effect of different distances of planting on the quality of the leaves*

Distance combinations	Strains	Amount of wrappers	Amount of fillers	Total yield	Percentage of wrappers [a]
		Kilos	*Kilos*	*Kilos*	
100×50 centimeters	14 Baker's Sumatra.	15.50	42.50	58.00	26.7
	1 Florida-Sumatra..	16.50	48.50	65.00	24.6
90×50 centimeters	14 Baker's Sumatra.	17.00	39.50	56.50	30.1
	1 Florida-Sumatra..	18.50	43.50	62.00	29.8
80×50 centimeters	14 Baker's Sumatra.	20.00	29.00	49.00	40.8
	1 Florida-Sumatra..	16.00	42.00	58.00	27.5
70×50 centimeters	14 Baker's Sumatra.	12.50	20.50	33.00	37.8
	1 Florida-Sumatra..	12.50	35.00	47.50	26.3
80×40 centimeters	14 Baker's Sumatra.	40.50	55.50	96.00	42.2
	1 Florida-Sumatra..	20.00	45.50	65.50	26.5

[a] Smooth, thin, less gummy, and light

Influence of distances on the prevalence and nature of diseases and insect pests.—During the season the important diseases and insect pests observed were leaf-spots of various forms, the common cut worms and plant lice. As naturally would be expected, the greatest infection by the diseases and attacks by the insects took place in the lots of closer distances of planting. The inevitable contact of the leaves as well as their reduced vegetative vigor indeed made them not only susceptible or favorable to the dissemination of the pathogenes but also preferred by the insects for being softer and less gummy, they were more palatable.

CONCLUSIONS AND RECOMMENDATIONS

Complete conclusions and recommendations to be derived from the observations and results just presented, obviously, cannot be emphasized inasmuch as it has been assured in the early part of this paper that this report is but preliminary. However, as the reader must have become aware of already, the following noteworthy facts have been quite well established for the trains, Baker's Sumatra and Florida-Sumatra under climatic and soil conditions typical of the Cotabato Valley:

1. Of the two strains tested, the 14 Baker–Sumatra is more adaptable in the production of wrapper than 1 Florida–Sumatra.
2. The best distance combination for 1 Baker–Sumatra is either 80 x 50 or 80 x 40 centimeters.
3. While 1 Florida–Sumatra does not produce as great a percentage of wrappers as the 14 Baker–Sumatra, its production is nevertheless quite fair when planted 90 x 50 centimeters.
4. If sufficient inducement could be obtained from interested representatives of important cigar factories in Manila, there is no reason why, the production of wrappers in a bigger scale could not be adequately encouraged in the Cotabato Valley.

LITERATURE CITATIONS

1. Coronas, Jose, 1920. The Climate and Weather of the Philippines, 1903 to 1918. Census of the Philippine Islands, 1918, **1** : 291–471.
2. Hesselbring, H., 1915. Efectos de la Sombra sobre la Transpiración y la Asimilacin de la Planta del Tabaco en Cuba. República de Cuba, Estación Experimental Agronómica, Bull. 24, 33 pp.
3. Paguirigan, D. B., 1916. The Production of Cigar Wrapper Tobacco under Shade in the Philippines. The Philippine Agriculturist and Forester, **5** : 39–49.
4. Tobacco Growing in the Philippines. Philippine Bureau of Agriculture, Bull. 34, 26 pp. 1919.
5. Tobacco Growing in Sumatra. The Philippine Agricultural Review, **16** : 3–11. 1923.

COÖPERATIVE MARKETING AS A FACTOR IN IMPROVING OUR AGRICULTURAL CONDITIONS

By JOSE S. CAMUS

Acting Chief, Agricultural Extension Division

While every effort is exerted in developing our agriculture by increasing our production, the writer believes that the desired result can not be obtained unless the farmers learn the methods of handling their products properly for the market through systematic coöperative marketing. A good farmer must not only know the best methods of farming; such as the proper preparation of the land, seed selection, crop rotation, the control and eradication of pests and diseases, but must also know the standardization of his products, as well as its proper packing and shipping before putting them on the market so that they may command a good price.

Our farmers today do not receive the full money value of their crops and find farming unprofitable for lack of systematic coöperative marketing. The introduction of this system into our farming activities would improve our agriculture in general, and would save our farmers from the usurers and speculators. Some farmers, especially those living in distant provinces, plant crops that will only supply home demand because they find it unprofitable to plant them in a large scale for lack of a good market, and, if there is any market at all, the price will not cover the cost of production and tansportation. The marketing expenses, however, can be minimized if the farmers will only group themselves and sell together their farm produce at regulated prices.

Thus, while it is important that our farming methods should be developed, it is equally necessary that the marketing side be improved in order that the farmers may get the full money value of their crops.

Although the organization for coöperative marketing is comparatively recent in the Philippines, there is no doubt that it can be carried out here successfully as in other countries. It may take time, however, before good results can be obtained but it will not take long before our farmers will see its value.

COÖPERATIVE ORGANIZATIONS ABROAD

The first agricultural coöperative organization formed was in Denmark, organized in the year 1860, with the object of improving the livestock and grain industry in that country. That organization, though of a different type from that of the present agricultural coöperative organizations, served its purpose, for the interest of the farmers was better taken care of and a great deal of work was done in improving farm seeds by producing better strains of plants and making these improved seeds available to the members of the society. Originally, it was composed of small farmers but later on the big wealthy landowners in Denmark joined the organization when they realized the value of coöperation in solving their agricultural problems. Because of this movement much was accomplished in increasing production and in suppressing monopolies which existed in that country.

The work of developing agriculture through coöperative work among the farmers is being done more or less successfully in almost every country in Europe, in India, and in the United States. In the countries mentioned above there are but a few coöperative producers' associations at present that can be considered really successful. It is only in 1895 that the agricultural coöperative organization became an important factor in the United States in improving agriculture. One of the earliest coöperative marketing associations organized in that country was the Cranbery Growers' Association of New Jersey and Massachusetts. This association was not wholly coöperative as the product was sold separately and the returns were made to each member, on the basis of the sale of his individual crop. The products were sold under the brand of the individual grower and not of the association. After a few years this method proved to be wholly unsatisfactory, and so the members decided to form a central agency, known as the National Fruit Company, which handled all the products of the member under the company's name.

At present the most successful work in coöperative marketing in the United States is found on the Pacific Coast among the fruit growers of California, Washington, and Oregon. At the beginning the farmers found out that the method of marketing their crop was a very complex business because of the nature of the fruits, which is perishable. It was then impossible to distribute them to all parts of the United States and to export them to foreign countries. As the fruits produced varied in quality, the associaton took charge of standardizing the fruits handled

and of packing and shipping them. By this process, grade and quality of the produce were assured and the association established a reputation. Later on a number of these local associations of growers grouped themselves into a central organization to handle their business on a more extensive scale. These organizations helped materially and were responsible for the success of the fruit industry in the United States today.

In 1914, an agricultural marketing society was organized in Burma to sell rice and peanuts direct to the wholesale dealers in Rangoon. The exporters protested to the Government of India claiming that the organized coöperative society had raised the prices of the products and as a result the merchants and consumers suffered. The committee assigned to investigate could not find any evidence to support the merchants' charges and the Government did not take further action. Due to the organization, unnecessary middlemen were eliminated and a better understanding between the wholesale dealers and the producers in India was established.

COÖPERATIVE ORGANIZATIONS IN THE PHILIPPINES

In the Philippines coöperation in various forms is part of the scheme of the work of our farmers, yet no efficient systematic organization on coöperative marketing was ever attempted until 1913 when work in this direction was started by the Bureau of Agriculture. Before this work was begun, the Director of Agriculture sent out letters to all provincial governors to find out what has been done along this line. From the replies received it appeared that no organization of this kind existed in the Islands except two of a quasi-coöperative character found in Bulacan Province, one operating a rice mill and another operating a rice-threshing machine. The societies were both composed of farmers who put up these machines for milling their own rice and those of others, charging some money or palay for milling.

Another association found was the Davao Planters' Association organized to foster and stimulate the cultivation of hemp in that province and to defend the interest of its members.

In July, 1914, an office of coöperative organization was created in the Bureau of Agriculture to induce the farmers to group together in order to better their conditions, and to pave the way for the solution of their marketing problems.

Ex-Vice-Governor Martin during his administration started the movement. The initial work done was the organization of municipal and provincial agricultural societies. It was planned

to have insular and provincial agricultural councils to look after the staple products such as abaca, tobacco, coconut, sugar and rice, and to organize the farmers according to their products. It was expected that through the organization of these coöperative agricultural societies the products of the members could be marketed coöperatively.

The support of the provincial and municipal authorities, the Constabulary and the schools, were secured in fostering this plan, and as a result there were 200 municipal agricultural societies organized by the Bureau of Agriculture in 22 provinces with a total membership of 15,000 in 1914 and a total of 286 municipal agricultural societies in the 29 provinces at the close of 1918.

Of these associations but a few succeeded to come up to expectations. Among the muncipal agricultural societies organized, the one in Pañgil, Laguna, which has conducted coöperative marketing successfully, is worth mentioning. This society started with small capital and gradually built up a fund amounting to ₱1,100. The members started the enterprise by buying the coconuts produced by the members and sold them direct to the wholesale dealers in Manila. Other societies which attained a similar success are the municipal agricultural society in Lumbang, Laguna and that in San Antonio, Zambales.

CHAMBERS OF AGRICULTURE

In 1922, at the convention held in Manila during the Carnival by the provincial governors, the presidents of the Agricultural Congress and of the Philippine Chamber of Agriculture, and the Secretary of Agriculture and Natural Resources, it was agreed upon to organize in the provinces, provincial and municipal chambers of agriculture in order to develop among the farmers a simple coöperative system of buying and selling their products and placing them on the market with the least possible intervention of the middlemen and the speculators.

PRODUCERS' ASSOCIATIONS

This plan was carried out in some provinces but the results obtained were not promising and so in April, 1922, another campaign was started to organize producers' coöperative marketing organizations, composed of farmers producing the same kind of crop only such as banana planters, vegetable raisers, poultry raisers, mango growers, tobacco producers, milk producers, etc. This plan was considered better than the previous ones for as the members produce the same kind of crops the association

can handle the business better and the members will have one common interest.

At the start many difficulties were encountered in organizing these producers' associations and pessimism prevailed in some quarters because of the sad experiences of the people due to the mismanagement and abuse committed by officers and other members of previous organizations. The middlemen capitalized these failures and opposed the new organization, but in spite of these difficulties, thirty local coöperative producers' associations were organized in 1923 by the Bureau of Agriculture.

Efforts were also made by the Bureau of Agriculture to enable these associations to market their products direct to Manila. To start with, a central milk agency was established in the city which handled the products of four milk producers' associations in the provinces. Later on the Rizal Farm Mercantile Coöperative Association of Caloocan, Rizal, has also established an agency in Manila. Another milk agency was established in San Fernando, Pampanga, by the Pampanga Milk Producers' Association where milk prepared in a sanitary way was handled locally in a commercial scale.

The products of the Banana and Papaya Growers' Associations, however, were sold to the Manila Fruit Company and the National Fruit Company established in the city, as well as to other dealers.

The only Tobacco Coöperative Producers' Association so far organized by the Bureau of Agriculture is the one in Nemmatan, Jones, Isabela. This association will handle the tobacco crop of its members. The adoption of better methods of culture and better handling of tobacco are among the helpful activities of the association.

The Bureau of Commerce and Industry is also working along this line, and has so far, according to information, organized a tobacco association in Tuguegarao. With the combined efforts of these two bureaus and the coöperation of the Bureau of Internal Revenue, more of these associations can be established in the Cagayan Valley which may be depended upon to solve the present tobacco problems.

Under the present method of marketing there is absolutely no incentive for the planters to produce better crop. The buying and selling of unstandardized products is not conducive to the production of better crop, as no better price is paid by the tobacco buyers for quality.

The tobacco crop passes through many hands before it reaches the manufacturer or exporter. As a consequence, the compensation of the intermediaries is added to the price of the product. Their elimination through coöperative marketing organization will, it is believed, redound to the benefit of the planters and the exporters, as the former will get the full value of their product, and the latter will pay a reduced price for the reason that they will not employ too many buyers as they do at the present time.

CONCLUSION

There is no reason why coöperative marketing cannot be developed in this country as with the development of coöperative marketing the farmers will undoubtedly get better price and will be able to dispose of their product more easily. They will also learn the standardization of the produce as to kind and quality; the proper distribution thereof to the market; the regulation of its supply and the proper method of selling and advertising, all of which are still not known to our farmers.

In the work of coöperative marketing three things can be demonstrated. First, agricultural coöperative marketing association creates a community spirit in any line they want to undertake; second, it serves as an important factor and as a medium in promoting agricultural interest in any province or municipality by increased production and by the standardization of products for the market; third, the success and failure of each association primarily depend upon the kind of management coupled with facilities.

Much has been said and written on the advantages of organizing coöperative associations with an encouraging, instructive and convincing suggestions. People read and realize all these advantages, but when they are put into practice it is suprising to meet so many obstacles and difficulties in persuading farmers to engage on this profitable way of doing business.

A noted economist has said: "Of all the classes of society the farmers are the most easily divided, the most reluctant to stand together for their common defense and the promotion of their common interest."

So far as I have observed, the following are some of the obstacles which cause failures in coöperative marketing work in this country:

1. The ignorance of proper method of marketing the product as a limiting factor in the dissemination of the value of coöperative marketing organization.

2. The lack of business ability of the officers and frequent and systematic supervision and auditing of the accounts of the association.

3. The lack of economy as a cause of failures of coöperative organizations, especially those just starting. Oftentimes the officers forget to exercise all economy possible that what little income the association may gain is also lost. It is very essential for any young association that its expenses do not exceed the income.

4. The general weakness of the coöperative spirit and loyalty of the members to support the society. Every member exercises his individuality, feels independent and in cases where societies exist, the members do not look upon themselves in any other light than to throw his advantage and competition with each other in securing personal interest to the society.

5. *Opposition.*—The question of opposition is closely allied to that of loyalty; for while loyalty is maintained opposition is ineffective.

PROGRESS REPORT ON FIVE NEW HYBRID VARIETIES OF TOBACCO

By M. E. GUTIERREZ
Assistant Agronomist

Along with the main work at the Pikit Tobacco Station on the production of wrapper tobacco, hybridization was carried on in the early part of 1922. For fine wrapper tobacco the station obtained indifferent results with native varieties, mostly introduced from the Cagayan Valley and with those imported from cool countries, with the notable exception of the Florida Sumatra. Most of the leaves of this variety were not even suitable for wrappers, execept when the plants were grown in the shade.

In the season of 1921–22, Sumatra seed furnished by Dean C. F. Baker of the College of Agriculture, Los Baños, Laguna, was planted at the station. Although the seed was recently introduced on account of the promising appearance of the plants in the field and their remarkable growth, it was expected that this variety would produce fine wrapper leaves. With the already acclimatized varieties and with the Sumatra, the station had the materials to start some preliminary hybridization work, using the Sumatra to improve our varieties that did not give the desired results in the production of wrapper leaves. It was not thought advisable to cross native varieties with each other or with the varieties from cool countries, because repeated cultures of these varieties showed that all the unit wrapper characters were not exhibited by them. This is not surprising, as tobacco is a plant which is highly responsive to climatic and soil conditions, notwithstanding the fact that some of the imported varieties may produce excellent wrapper leaves in the countries of origin.

The choice of the newly introduced Sumatra used for improving the station varieties was well made, as at the close of the season it produced fine wrapper leaves both in the open and in the shade. The lower standard leaves produced fine *claro* color, in spite of the fact that the soil in Pikit is too black for the production of light colored wrappers. Moreover, subsequent cultures of this variety showed that it is less susceptible

to fungus diseases, does not sucker freely, and can withstand adverse conditions of weather better than the other varieties grown at the station. The position of the leaves, being erect with the tips slightly drooping, is one of its advantages over the others, as this protects the leaves from receiving directly the rays of the sun. This unit wrapper character is distinctly conclusive that fine textured leaves can be produced.

It would not be amiss to give a few remarks regarding the station varieties that needed improvement, as from these it will be understood why it was necessary to resort to hybridization in order to ameliorate said varieties.

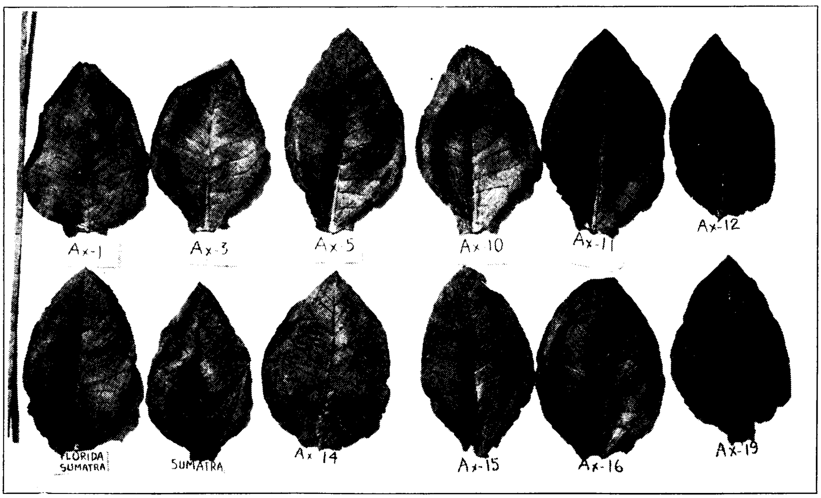
1. *Florida-Sumatra.*—This variety introduced by the Bureau of Agriculture in 1919 was planted for three successive seasons at the station, beginning in 1920. The plants are very stocky with large broad close-set leaves with blunt tips. The leaves being almost elliptical in shape are desireable for wrapper. The leaves being larger than those of the Sumatra, have coarser veins, but each leaf yields more cigar wrappers. Under Pikit conditions the leaves produced are generally between *colorado claro* and *colorado* in color after curing. The cured leaves have an agreeable aroma. It may be used for two purposes; namely, for wrapper and for filler. Its principal defects are its coarse veins, its free suckering habit, easy susceptibility to diseases and insect pests, and sensitiveness to adverse environmental conditions. A Florida-Sumatra plant from a selected strain, the result of 3 seasons' work of inbreeding is shown in figure Plate 1 (*b*).

2. *Dammao Broadleaf.*—This variety came from Dammao Tobacco Station in Isabela and was introduced in Pikit in 1920. It was subjected to the best cultural treatment in the open for the production of wrapper leaves, but only a small percentage of leaves produced were suitable for this purpose. The fermented leaves were more suitable for binders and fillers than for wrappers. This variety was affected by chlorosis, a physiological disease; but strain $2F_2$—6 was isolated which was resistant to that disease. The best plants from this strain were used for hybridization. The leaves, are large and broad, but have very coarse veins, and the surface of the leaves is very wavy. Due to the defective position of the large leaves, being drooping with the tips of the lower standard leaves almost flush with the ground and with the resultant close overlapping, preventing proper aëration, the leaves are easily affected by fungus diseases.

(*a*) Baker's Sumatra

(*b*) Florida-Sumatra, the result of three generations of in breeding

(*a*) Plant-to-the-row test with the Baker's Sumatra X Florida Sumatra (Ax—hybrid)



(*b*) Shapes of leaves of the different strains of Baker's Sumatra X Florida-Sumatra

6. *Connecticut Broadleaf*.—Due to the rather warm climate at Pikit or to the character of its soil or both conditions combined, this variety produced very thick, dark colored leaves with rather coarse veins, rather long and oblong in shape and altogether unsuitable for wrapper. Under the conditions at Pikit wrapper leaves could not be produced from this variety.

13. *Havana*.—This variety introduced into the Philippines from Cuba was sent in 1920 to the station by the Central Office of the Bureau of Agriculture. This is the tobacco that made Cuba famous and is now everywhere grown in that island. Havana variety in its native home produces the three classes of leaves required by the factory in the manufacture of cigars; namely, wrappers, binders, and fillers. But at this station after three successive seasonal trials covering a period of three years it did not produce good wrapper leaves. The leaves were rather small, thick, and of bright brown color, very suitable for fillers but certainly not fit for wrappers. The variety as cultured at this station answers the description of Paguirigan as published in Vol. 16 (1923), No. 3, page 175 of the "Philippine Agricultural Review."

The object of this hybridization work was to get a combination of desirable wrapper characters, most of which were well exhibited by the Sumatra varieties as grown under the climatic and soil conditions at Pikit. The other varieties did not show these wrapper characters but only to a limited extent.

At the early part of 1922 the writer made the following crosses:

14 Sumatra X $1F_1$—2 Florida-Sumatra.
$1F_1$—6 Florida-Sumatra X 14 Sumatra.
$2F_1$—6 Dammao Broadleaf X 14 Sumatra.
$6F_1$—2 Connecticut Broadleaf X 14 Sumatra.
13 Havana X 14 Sumatra.

The first number is the number as given to the original seed received and entered into our accession book; the number after the dash is the strain number.

With the exception of the first cross, the Sumatra was used as the male or staminate parent, because in tobacco hybridization "the physical characters of the staminate parents are generally dominant over those of the pistillate.[1]" As stated in the beginning of this paper, the intention in this hybridization work was to have the four varieties improved in the di-

[1] Tirona, The Philippine Agriculturist and Forester, Vol. 3 (1914), No. 1, p. 7.

rection of wrapper production by the infusion of the Sumatra "blood."

In the season of 1922–23 the hybrid tobacco seed resulting from the cross were planted in small plots. The plants grew vigorously. From this F_1 hybrid generation, selections and in-breeding of the best mother plants were made by the writer, for plant-to-the-row tests, in order to isolate in the F_2 generation a number of strains having the most desirable types for the production of wrapper leaves. During the 1923–24 season this work was in progress. The result of this hybridization work combined with selection will be published in a separate paper. The F_2 generation furnished the data for the present descriptions.

The present cultures of these five hybrids show that they have certain advantages over their parents in luxuriance, vigor, earliness, size of leaves, rapidity of growth and other important characters. In this respect they are distinct improvements. For this reason and in order to acquaint the readers with these new hybrid tobacco varieties, the detailed botanical descriptions are given hereunder:

14 SUMATRA X 1F_1—2 FLORIDA-SUMATRA (AX-HYBRID)

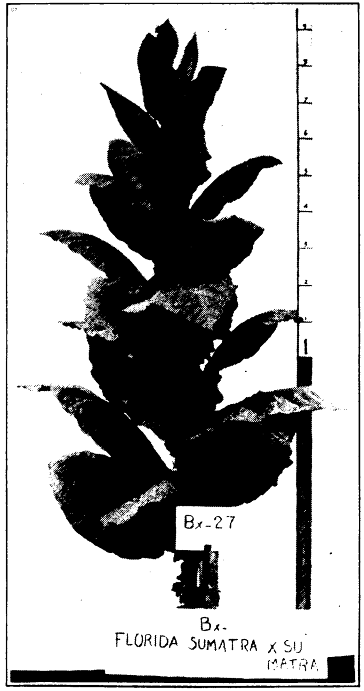
Plants very vigorous, varying from 1.7 to 3 meters high; stem from 6.9 to 10.7 centimeters in circumference; total number of leaves from 27 to 42; number of standard leaves from 17 to 30; length of middle internode from 4.5 to 8 centimeters.

Leaves erect; angle of insertion from 35 to 59 degrees; broad, oval to ovate in shape; surface flat; color between light green and green; pubescent; margin undulate; base auriculate-clasping; petiole broadly winged; apex acuminate to obtuse, slightly drooping; lower standards from 4 to 5.5 decimeters long; 2.5 to 3.5 decimeters wide; ratio of length to breadth $1\frac{4}{7}$ to $1\frac{3}{5}$ times longer than wide.

Inflorescence leaves 45 to 50 degrees as angle of insertion; shape oval; apex acute; margin slightly undulate; surface flat to convex.

Inflorescence open type; flowers in panicles; sparsely arranged; medium in size. Calyx 10 to 12 millimeters in diameter, 18 to 22 millimeters long, gamosephalous, 5 teeth, posterior always longer than the rest; long and acute; shape globular with distinct median construction; midrib of sepals well marked as a distinct dark green ridge. Corolla salver form; appearance not fully expanded; color generally light pink; lobes ovate, edges curved inwards; spread of corolla lobes

(*a*) Plant of the Ax—hybrid



(*b*) Plant of the Bx—hybrid

from 18 to 28 millimeters; divisions apical, points small. Anthers 3.5 to 5 millimeters long; 1.5 millimeters thick, pollen abundant; style 4 to 4.5 long; ovary from 6 to 7 millimeters long. Capsule large; 22 millimeters long; shape conical; apex umbilicate.

This cross is a wrapper type, superior in general vigor, height, and size of leaves over any of its parents. It is a distinct improvement over the male or staminate parent, the Florida-Sumatra, as its leaves have finer texture and smaller veins, less gummy, and more resistant to chlorosis, fungus diseases and pests. It suckers less than the male parent.

$1F_1$—6 FLORIDA-SUMATRA X 14 SUMATRA (BX-HYBRID)

Plants very vigorous, varying from 1.8 to 3.05 meters high; stem from 6.2 to 10 centimeters in circumference; total number of leaves 24 to 42; number of standard leaves from 17 to 30; length of middle internode from 4 to 10 centimeters.

Leaves erect; angle of insertion 30 to 45 degrees; broad, oval to ovate in shape; surface flat; color from light green to green; pubescent; margin undulate; base auriculate-clasping; petiole broadly winged; apex acuminate to obtuse; slightly drooping; lower standards from 4 to 6 decimeters long; 3 to 4 decimeters wide; ratio of length to breadth $1\frac{1}{3}$ to $1\frac{1}{2}$ times longer than wide.

Inflorescence leaves 45 degrees as angle of insertion; shape oval; apex acuminate; margin slightly undulate; surface convex.

Inflorescence open type; flowers in panicles; sparsely arranged; slender in size. Calyx 7 to 10 millimeters in diameter; 15 to 21 millimeters long; gamosephalous, 5 teeth, posterior always longer than the rest; long and acute; shape globular with distinct median constriction; midrib of sepals, well marked as a distinct dark green ridge. Corolla salver forms; appearance not fully expanded; color from very light pink to pink; lobes ovate with undulating appearance; spread of corolla lobes from 20 to 25 millimeters divisions apical, points small. Anthers 3 to 4 millimeters long; 1 to 1.5 millimeters thick; pollen abundant; style 4 to 4.3 centimeters long; ovary 5 to 7 millimeters long. Capsule large 17 to 21 millimeters long; shape conical; apex umbilicate.

This hydrib is a wrapper type, better in more than one respect than the first reciprocal cross, Sumatra X Florida-Sumatra (Ax-hybrid), as the predominating characters are those of the staminate parent, the Sumatra. The plants are slightly more

thrifty and vigorous, greener in appearance, and the present culture contains less pathological forms than the Ax-hybrid. The leaves are larger and broader and have the shape of those of the Sumatra. In wrapper characters this hybrid is very much superior to the pistillate parent, the Florida Sumatra.

$2F_1$—6 DAMMAO BROADLEAF X 14 SUMATRA (CX-HYBRID)

(Shortened name, "DAMATRA")

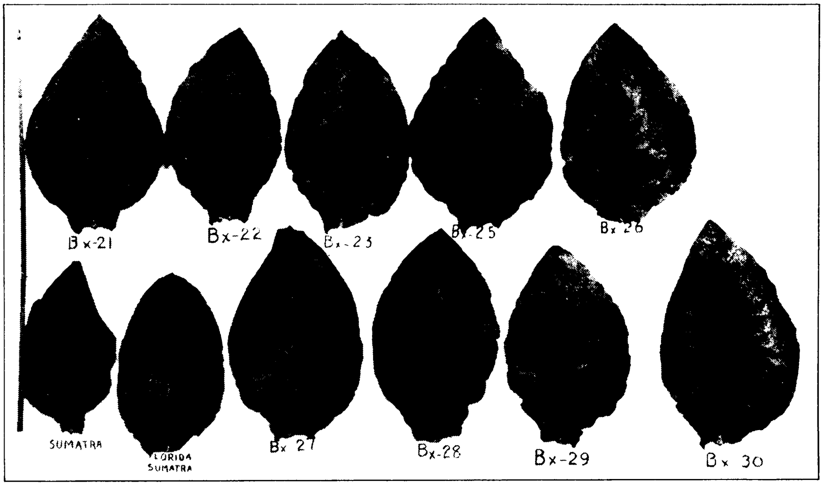
Plants vigorous, varying from 1.6 to 2.9 meters high; stem from 5.7 to 9.4 centimeters in circumference; total number of leaves from 21 to 33; number of standard leaves from 13 to 24; length of middle internode from 6 to 10 centimeters.

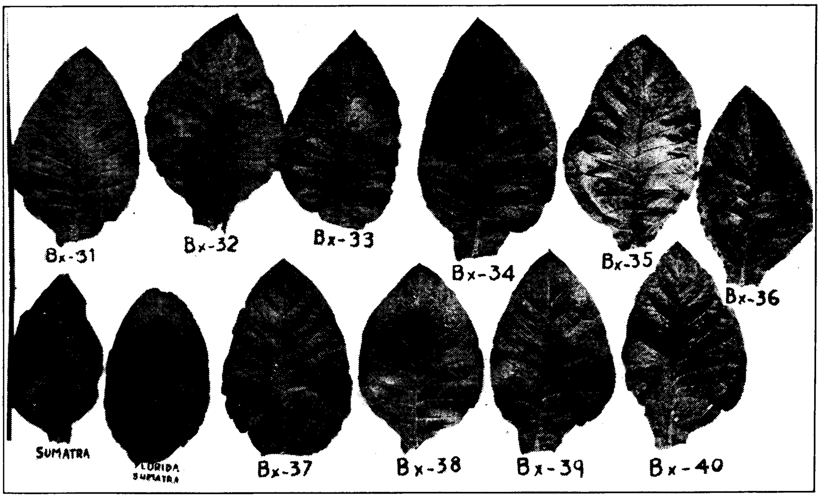
Leaves broad, oval to ovate in shape; surface flat to wavy; color green; pubescent; margin undulate to very undulate; base auriculate-clasping; petiole broadly winged; apex acute to acuminate; generally drooping about half from the base; angle of insertion from 45 to 70 degrees; lower standards from 4 to 5.5 decimeters long; 2 to 4 decimeters wide; ratio of length to breadth $1\frac{3}{8}$ to $1\frac{3}{5}$ times longer than wide.

Inflorescence leaves 60 to 70 degrees as angle of insertion; shape oval; apex acute; margin undulate; surface flat.

Inflorescence open type; flowers in panicles; sparsely arranged; slender to medium in size. Calyx 9 to 13 millimeters in diameter; 17 to 20 millimeters long; gamosephalous, 5 teeth, posterior always longer than the rest; long and acute; globular with distinct median constriction; midrib of sepals well marked as distinct dark green ridge. Corolla salver form; appearance generally flat; color pink; lobes ovate; spread of corolla lobes from 25 to 27 millimeters; divisions apical, points small. Anthers 4 to 5 millimeters long; 1.6 millimeters thick; pollen fairly abundant; style 4.3 to 4.5 millimeters long; ovary 7 to 9 millimeters long. Capsule large; 21 to 23 millimeters long; shape conical; apex umbilicate.

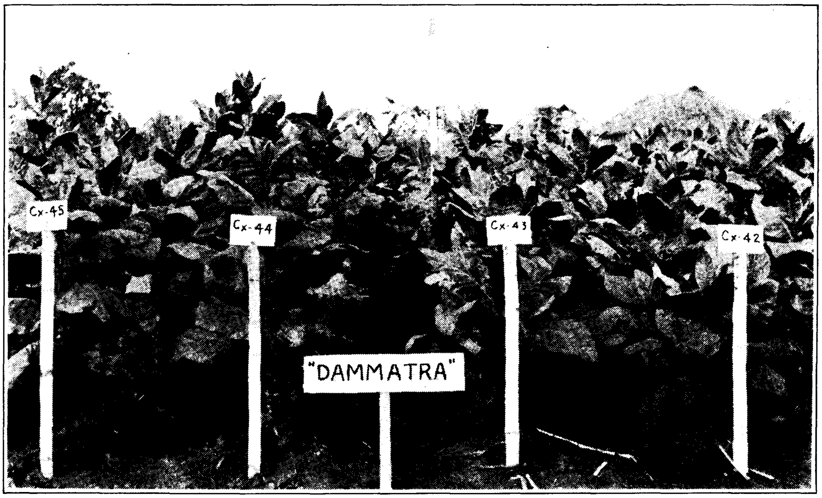
This hybrid is a wrapper type, generally with intermediate characters between both parents. Some of the forms retain the characteristic leaf habits of the Dammao Broadleaf, especially in the way the leaves are borne on the stem, being oblique to horizontal, the wavy character of the surface and the very undulating margin; other forms show more the distinguishing characteristics of the Sumatra. The latter are being isolated. The leaves are finer in texture and shorter than those of the pistillate parent. Only half from the base of the leaf is drooping instead of the whole leaf as in the case of the





Shapes of leaves of the different strains of the Florida-Sumatra X Baker's Sumatra

(*a*) Plant-to-the-row test with Florida Sumatra X Baker's Sumatra (Bx—hybrid)



(*b*) Plant-to-the-row test with Dammao Broadleaf X Baker's Sumatra ("Damatra")

Dammao Broadleaf. On account of the better arrangement of the leaves, being not so closely overlapping due to the drooping character, the leaves are less susceptible to fungus diseases. There is also a total absence of chlorosis due to the resistant strain of the Dammao Broadleaf used in the cross.

6F$_1$—2 CONNECTICUT BROADLEAF X 14 SUMATRA (DX-HYBRID)

[Shortened name: "CONMATRA"]

Plants vigorous, varying from 1.6 to 2.3 meters high; stem from 5.6 to 9.1 centimeters in circumference; total number of leaves 19 to 32; number of standard leaves 12 to 22; length of middle internode from 5 to 10 centimeters.

Leaves erect; angle of insertion from 30 to 45 degrees; fairly broad, oblong to oval in shape; surface flat; color green; pubescent; base auriculate, slightly clasping; petiole broadly winged; apex acute to obtuse slightly drooping; lower standards from 4 to 6.4 decimeters long; 2 to 4 decimeters wide; ratio of length to breadth $1\frac{3}{8}$ to 2 times longer than wide.

Inflorescence leaves 65 degrees as angle of insertion; shape lanceolate; apex acute; margin silghtly undulate; surface flat to concave.

Inflorescence elongated type; flowers in panicles; slender in size; calyx from 10 to 12 millimeters in diameter; 18 to 22 millimeters long; gamosephalous, 5 teeth, posterior always longer than the rest; long and acute; shape globular with distinct median constriction; midrib of sepals well marked as distinct dark green ridge. Corolla salver form; appearance not fully expanded; color light pink; lobes ovate, edges curved inwards; spread of corolla lobes 18 to 25 millimeters; divisions apical, points small. Anthers 4 to 5 millimeters long; 1 to 1.5 millimeters thick; pollen abundant; style 3.6 to 3.8 centimeters long; ovary 5 to 6 millimeters long. Capsule large, 20 to 22 millimeters long; shape conical; apex umbilicate.

This hybrid is a wrapper type. It seems that it is better adapted to our local conditions of climate and soil than its indifferent female parent, the Connecticut Broadleaf. The characters of the Sumatra, the staminate parent, are dominant over those of the pistillate. There are great improvements in the shape and texture of the leaves.

13 HAVANA X 14 SUMATRA (EX-HYBRID)

[Shortened name: "HAVAMATRA"]

Plants very vigorous, varying from 1.6 to 2.4 meters high; stem from 6.3 to 8.8 centimeters in circumference; total num-

ber of leaves from 21 to 34; number of standard leaves from 14 to 25; length of middle internode from 5.5 to 9.5 centimeters.

Leaves generally erect; angle of insertion 45 degrees; broad, oval to ovate in shape; surface flat; color green; pubescent; margin slightly undulate; base auriculate slightly clasping; petiole broadly winged; apex acuminate to obtuse, slightly drooping; lower standards from 4 to 5.5 decimeters long; 2.5 to 3.5 decimeters wide; ratio of length and breadth $1\frac{4}{11}$ to $1\frac{3}{8}$ times longer than wide.

Inflorescence leaves 45 to 65 degrees as angle of insertion; shape lanceolate to oval; apex acute; margin slightly undulate; surface flat to concave.

Inflorescence elongated type; flowers in panicles sparsely arranged; slender in size. Calyx from 6 to 10 millimeters in diameter; 17 to 19 millimeters long; gamosephalous, 5 teeth, posterior always longer than the rest; long and acute; shape globular with distinct median constriction; midrib of sepals well marked as a distinct dark green ridge. Corolla salver form; appearance not fully expanded; color from very light pink to pink; lobes ovate, edges curved inwards; spread of corolla lobes from 25 to 27 millimeters; divisions apical, points small. Anthers 4 to 4.5 centimeters long; 1 to 1.5 millimeters thick; pollen abundant; style from 3.6 to 4 centimeters long; ovary from 5 to 6 millimeters long. Capsule large, 18 to 20 millimeters long; shape conical; apex umbilicate.

This hybrid is a wrapper type. It surpasses its female parent the Havana in vigor; size and shape of leaves and in texture. The predominating characters are those of the Sumatra. This hybrid seems to give better results in the production of wrapper leaves under local environment conditions than the Havana. Figure 10 shows four rows of this hybrid.

Plant-to-the-row test with Havana X Baker's Sumatra ("Havamatra")

PROGRESS REPORT ON ADLAY[1]

By P. J. Wester

The variety trials with several native kinds of adlay (Plate VII) have been continued at the Lamao Experiment Station.

Mr. H. T. Oberly, commercial manager of the Philippine Engineering Company, Manila, last year called the attention of the Bureau to their "Jrus" mill, as possibly being suitable for hulling and grinding adlay. Since on examination it appeared that the mill would be serviceable for the purpose, arrangements were made to experiment with it after the grain was harvested. These experiments turned out so successful that the entire quantity of adlay flour used for the demonstrations during the Carnival in February in Manila was ground on this mill.

On request, the Philippine Engineering Company later furnished the following estimates for a complete mill:

ESTIMATE NO. 1

1 Hopper.
1 Single wooden elevator with iron top and bottom case provided with pulley and buckets, 3″ wide.
1 Jrus Hulling Mill No. 6, diameter of stone 24″.
1 Single elevator as above.
1 Aspirating husk fan with sifter mounted on top to separate the hulls and kernels.
1 Jrus Grinding Mill No. 6, diameter of stone 24″.
1 Aspirating fan with shaking-sieve atop to separate fine and coarse products.
1 Complete galvanized iron tubing to interconnect all apparatus as specified above.

The necessary iron frame for mounting the hull aspirating fan above the grinding mill.

Complete shafting with bearings, pulleys, belts, and foundation bolts.

Price of machinery as specified above, ₱3,000.

Power required: About 52 H. P.

Capacity: Approximately 80 kilos per hour of baking flour.

ESTIMATE NO. 2

1 Jrus Hulling Mill No. 6, diameter of stone 24″.
1 Single elevator with corresponding pulley and buckets, 3″ wide.

[1] For previous articles about adlay, *Coix lacryma-jobi* vor. *mayuen*, see this Review, Vol. XIII, p. 217; XIV, pp. 159 and 168; and Vol. XVI, pp. 197, 201, 205, and 212.

1 Aspirating husk fan with sifter.
1 Jrus Grinding Mill No. 6, diameter 24"..
1 Aspirating fan with shaking-sieve atop to separate fine and coarse products.
Galvanized iron tubing to inter-connect all the apparatus as specified above.
Complete shafting, etc.

Price, delivered f. o. b. Manila, ₱2,500.
Power required: 20 H. P.
Capacity: 70 kilos per hour of baking flour.
Please note that the under frame for mounting the aspirating husk fan has to be made of wood.

In addition to the above specified machinery, it would be necessary to add to each estimate a receiving separator to clean the grain from impurities before it goes to the huller at a cost of ₱180.

Some 70 loaves of graham-adlay bread were baked by the Sanitary Bakery, Manila, the manager of which, Mrs. F. Herier, was so well pleased with the quality of the bread produced that she stated that she would buy adlay flour in quantity whenever it was placed on the market, confident that there would be a good demand for adlay bread.

A large quantity of cakes, biscuits, and muffins were made by the La Perla biscuit manufacturers and Mrs. C. E. Becker, both of Manila, which together with bread were used in the demonstrations. Two demonstrations were made at the Ayuntamiento, Manila, where the adlay products were served at a luncheon and a tea, where many prominent people were present.

Mr. Jose G. Sanvictores, Director of the Bureau of Non-Christian Tribes, furnished the Bureau of Agriculture several sacks of adlay and provided space for the exhibition of the Jrus mill at the Mindanao and Sulu exhibit in the carnival grounds where adlay and adlay literature, bread and other products were distributed.

In this way numerous people made their first acquaintance with adlay as a breadstuff.

The late Mr. Dean C. Worcester, formerly Secretary of the Interior of the Government of the Philippine Islands, and later manager of the Philippine Refining Corporation, after sampling the bread became much interested in the possibilities of the grain and at his invitation a sample of adlay was brought to the oil mill for a milling trial on a Braun pulverizer, manufactured by the Braun Corporation, Los Angeles, California.

Adlay ready for the harvest. Lamao Experiment Station

The hulling on this machine was exceptionally well performed, with fewer broken kernels even than by the Jrus mill, which means less waste in milling.

As a result of the publicity given adlay in this and other publications, requests for seeds have arrived from many countries. Seed was mailed to the Director of Agriculture in Ceylon among others in 1921, and from this the third crop has been harvested. The following account is quoted from the Progress Report of the Manager of the Peradeniya Experiment Station, Ceylon, (*Tropical Agriculturist,* Vol. LXII, No. 5, p. 246, 1924:

"ADLAY, *Coix lacryma-jobi*

A crop of this food grain harvested in December yielded 69 bushels or, 2,484 pounds of grain and 22,060 pounds of straw per acre.

This yield was obtained in plot C 4 of the annual economic area which received an application of the 16 tons cattle manure per acre. * * * Fifteen small lots of grain was distributed to Experiment Station employees including Tamils, Sinhalese, and Mohammedans. Some cooked and ate the grain as rice, some made the flour into a dish known by Singàlese as *Pittu* and by Tamils as *Pattu,* and some made it into *Roti.* All expressed their approval of the grain as a food and their willingness to buy it when available. When it is considered that in food value adlay is superior to rice, wheat, or oats, and that yields as quoted above can be obtained the grain appears to deserve considerable attention. A further area has been sown. Six varieties obtained from the Philippine Islands have also been harvested and the seed reserved for varietal tests.

Expressed in terms familiar to readers in the Philippines the yield obtained in Ceylon is at the rate of 2,796 kilos, and 169 bushels, or 80 cavans of grain per hectare.

The following excerpt from a letter recently received from Mr. Philip Jones, superintendent of the San Ramon Penal Farm, Zamboanga, may be of interest:

I find that our corn grinder at San Ramon can be adjusted so that it hulls and grinds the grain very satisfactorily. It will not, however, grind it fine enough for flour. But for a breakfast food, or for a substitute for rice it is sufficient.

I have tried the adlay myself, as a breakfast food, and I like it very much. Also, the prisoners like it very much better than rice.

In a previous letter Mr. Jones says:

The adlay which you gave to Major Barros was planted and is now ready for harvest. It has grown exceedingly well, and the grain seems well matured. It is remarkable how this plant has survived the dry weather. Palay (rice) which was planted at the same time has been entirely burned up by the protracted dry weather we have had ever since last October, yet the adlay does not seem to have suffered a bit.

Of course, adlay will not grow everywhere and under any conditions, but it does so well and is so productive when its requirements are met that its culture should not be given up from a first trial resulting in failure. Unseasonable planting gives a poor yield. Then, we have found that varieties from high elevations do very poorly when planted near sea level and vice versa.

In the course of the milling and baking trials it was found very important that the grain be well dried before it is milled, because if it is incompletely dried, the flour rapidly becomes musty and rancid, the latter no doubt because of the great amount of fat contained in the grain. Indeed, some varieties are so rich in fat that it is possible that they will be found unsuitable for milling into a flour of good keeping quality.

The keeping quality of flour made of Bukidnon adlay was tested this spring, a bag of flour being kept in a pantry beside wheat flour. Except for the infestation of weevils which apparently found the adlay flour very appetizing, and had to be sifted out repeatedly, the flour remained in good condition at the expiration of three months when the experiment was discontinued.

Several months ago the suggestion was made to the writer that commercial gluten might be used in place of wheat flour in making adlay bread, and he then wrote to Dr. C. F. Langworthy, Chief, Office of Home Economics, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, and inquired about the possibilities in this direction. The following reply from Dr. J. H. Shollenberger is both interesting and suggestive to bakers and housewives who may wish to use adlay flour:

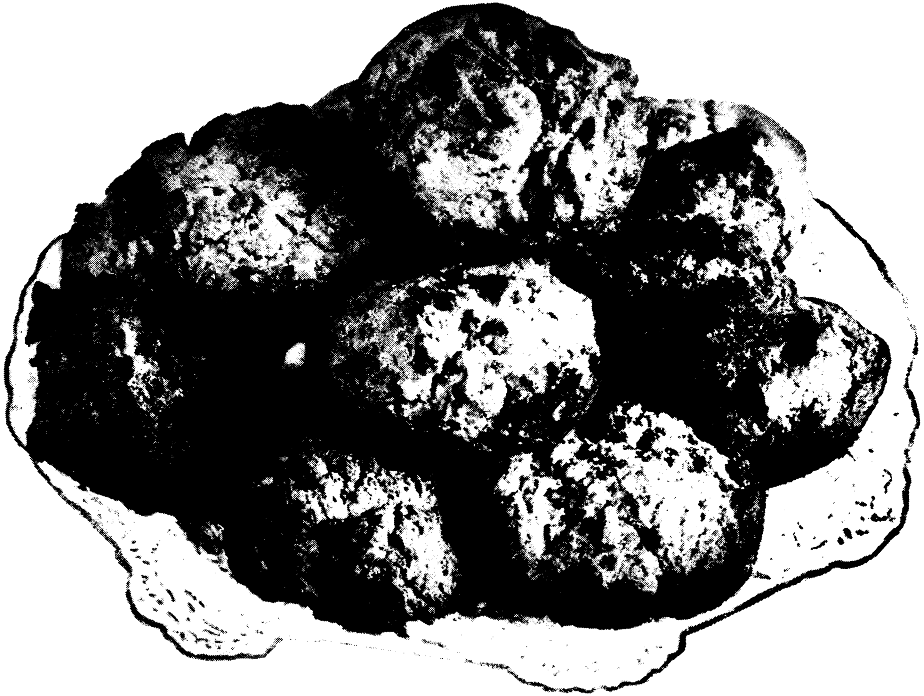
UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF AGRICULTURAL ECONOMICS
WASHINGTON

March 1, 1924

DEAR MR. WESTER:

Your letter of December 27, 1923, to Dr. C. F. Langworthy, regarding the addition of gluten from wheat flour to adlay flour has been referred to this office for reply.

I cannot state as to the practicability of the idea as this office has not carried on any experiments of this kind. However, Bulletin No. 139, entitled "Some Factors Related to the Quality of Wheat and Strength of Flour," of the North Dakota Experiment Station, Agricultural College,



A plate of adlay biscuits, made of equal parts of whole-adlay and wheat flour

North Dakota, contains results from adding gluten to wheat flour in addition to the normal amount present. The results of these experiments are given below:

TABLE I.—*Showing the influence of added Gluten on strength of wheat flour*

Samlpe	Protein content	Loaf volume	Color of crumb	Texture of crumb
Check sample	12.37	2,670	95	96
Check plus gluten	15.00	2,790	95	96
Check plus gluten	40.00	3,240	85	94
Check plus gluten	100.00	[1]7,000		

[1] Calculated from a smaller quantity

The author of this bulletin says, "It is interesting to note in studying the influence of the quantity of protein on strength what happens upon increasing the percentage much higher by the addition of extra gluten. The volume produced by an amount of gluten (dry basis) equal to the quantity of flour used per loaf in the regular baking tests (340 grams normal moisture basis) provided so large a quantity would respond relatively the same as a smaller quantity, would be 7,000 cubic centimeters."

This author also states,—"The relative efficiency of protein in the softer wheat is not as great as the same percentage in bread wheats."

In so far as I have been able to find out, gluten flour which is sold on the market there in Washington for the purpose of making gluten bread (the gluten flour guaranteed to contain 40 per cent gluten) sells at the place of manufacture for $40 per barrel (196 pounds). A baker in this city tells me that with a higher percentage of gluten than this it would be almost impossible to make a commercial loaf of gluten bread that would be acceptable to the users of such bread.

As you probably know, it is more the quality of gluten in wheat flour than the quantity that gives the flour its baking strength. Although I am not familiar with the gluten product sold on the market, it occurs to me that it would not possess the necessary quality even when mixed with wheat flour that it had before it was washed from the flour due to its different physical properties. Therefore, it occurs to me that if any blending of this substance with adlay is to be practiced it would be cheaper and more satisfactory from a bread making standpoint to mix some of the high quality hard wheat flours with whatever percentages of adlay that may be found desirable.

The commercial grade of flour known as "low grade" is sometimes erroneously called gluten flour because it contains a few per cent more of protein than the "patent," "clear," and "straight" grades milled from the same wheat. The quality of the gluten in this "low grade" flour, however, is inferior to that in the other grades. This grade of flour can be purchased at prices much lower than the patent grades, but because of its low quality, I do not believe it would be satisfactory for your purpose.

Very truly yours,

J. H. SHOLLENBERGER
Milling Investigations

Major problems in connection with adlay which still remain to be worked out relate to:

1. The vitamine content and the digestibility of the grain of the different sorts.

In this connection it is interesting to recall that food prepared from adlay has been recommended for invalids, and that in Tonkin, adlay is spoken of as the "grass of life and health," and that there is very considerable variation in the analysis of the grain in the different forms of adlay. See this REVIEW, Vol. XIII, p. 221, and Vol. XIV, pp. 161 and 165.

2. The practicability of using the grain for the manufacture of biscuits and hardtack, and for beer.

The late Dean C. Worcester stated that beer made of adlay by the Bukidnons was of very good quality, while in *Commercial Products of India,* Watt says about adlay beer: "I have personally experienced much pleasure while traveling in the Naga hills in partaking of the fresh *dzu* offered in friendly salutation. It is something in flavor between that of buttermilk and cider, and on a hot day at the termination of a long march is most acceptable. Some of the forms of *coix* (adlay)—are said to give the beer a fruity flavor and aroma."

3. The possible utilization of the straw for the manufacture of paper.

If the dried straw would be found to make good paper material this would naturally increase the revenues of the planter of the grain.

THE PAST AND PRESENT WORK OF LA CARLOTA EXPERIMENT STATION

By SILVESTRE ASUNCION
Superintendent and in charge of Sugar Cane Investigation
La Carlota Experiment Station

INTRODUCTION

The La Carlota Experiment Station was established during the Spanish regime and it was known as La Granja Modelo. The station was established to meet the demand of the planters in Negros. As Negros became a sugar district, the station began also to plant sugar cane, and a muscovado plant was put up to grind the cane. At that time the work of the station was run by *aparcería*. During the revolution, in 1896, the work of the station was paralized and the work was not resumed till after the year 1909.

Mr. H. J. Gallagher of the Bureau of Agriculture took possession of the place as superintendent of the station. He planted sugar cane and ran the muscovado plant. During his time part of the station was converted into pasture for the newly imported animals from India. This was done in order to meet the demand of the planters for better grade of work animals because at the time rinderpest was so prevalent that many of the work animals died in Negros. The imported animals from India are to some extent immune to the disease.

Later this work on the production of muscovado was abandoned and the muscovado plant was diposed of. From that time up to 1922 the activity of the station was confined to growing different crops; such as, corn, rice, abaca, maguey, fruit trees, and including, of course, the cultural experiments of sugar cane, etc. The experiments on the different projects besides sugar cane were carried out at La Carlota, because of lack of place in the other stations of the Bureau. The Bureau of Agriculture later on, however, was able to confine its activity to sugar cane and animals. As the records obtainable are from 1915 only, the following projects are described:

UPLAND RICE PROJECT

The upland rice project of the La Carlota Experiment Station has been conducted since 1915 with general seed selection and

miscellaneous cultural experiments. From this time up to 1922 the number of experimental jobs increased to 7 in number. The following were the experimental jobs:

1. Seed longevity tests.
2 Acclimatization tests.
3. Head-to-the-row tests.
4. General seed selection.
5. Variety tests.
6. Drill method *vs.* Native method of planting.
7. Irrigation experiment.

Seed longevity tests.—The object was to determine how long seed palay could be kept without injuring its vitality by placing it in available containers. Seed palay of different varieties has been placed in seed cans with wood ash sprinkled over the seed; placed on top of and in sacks and basket with wood ash over the seed; a regular sized bundle of seed palay in heads was also left hanging uncovered near the above containers.

From the two tests made it was found that the basket as container for seed palay is the best among the containers used.

A test was made by placing the seed palay in sacks without any ash and it was found to lose their vitality in one year's time.

Acclimatization tests.—The object in view was to acclimatize the high yielding varieties both native and foreign, for distribution among the rice growers in Negros.

These tests were started in 1918 and stopped in 1920.

The foreign varieties were mostly from Japan, China, Saigon. Siam, and the United States; while the native varieties came from different provinces of the Philippine Islands.

The Results from three years' testing have shown that most of the foreign varieties do not thrive well and do not show their high yielding quality in this place, with the exception of a few which give higher yields than many of the native varieties. The foreign varieties found to be acclimatized in this place and to give good yield are 1188 Sekitori, 1290 Blue Rose I, and 1266 Early Prolific.

Native varieties are found to be admixtures, that is, in variety there exist at least two different kinds of grains with red and white cuticles. Some are found also to be poor yielders.

Head-to-the-row tests.—The object was to isolate the best strains within a high yielding variety. After isolation the best strains were multiplied and distributed to the rice growers in Negros.

Every good selected head from the selected plants was planted to the row. This had been done for two years only, due to lack of funds. Five high yielding varieties were used. From these, several high yielding strains in each variety were isolated and transferred to Lamao Experiment Station. The experiment is being continued there.

General seed selection.—The object is the isolation of the best yielding plants which are also resistant to diseases and pests.

The seeds of these were used for every next planting season.

The result shows that yields increased and better stand of plants than before was secured.

Variety tests.—The object is the isolation of the high yielding varieties.

This experiment was started since 1916 with 49 varieties. The number of varieties increased gradually to 166 in number. The varieties were from the different places in the Islands and from Japan, China, Saigon, and United States.

From the six years tests of this experiment there have been found 27 varieties that are very good yielders. Their yields range from 41.3 to 61.3 cavans per hectare. The rest are found to be poor yielders.

Most of these varieties have been distributed to rice growers nearby.

Drill method vs. Hill method of planting upland rice.—The object is to determine the cheapest method of growing upland rice with good returns.

This experiment was conducted in 1922 with two varieties; namely, Mayoro II and Tuhao or Caot.

In the drill method of planting seeds were planted in drills in the rows of 50 centimeters apart to allow animal cultivation.

In the hill method seeds were planted 30 x 30 centimeters apart. The average number of plants per hill was 12. Every expense incurred in each experiment was noted separately. Cultural treatments needed by each were given.

The drill method of planting upland rice was found to be more economical and more crop was obtained from the same given area than the hill method.

Irrigation experiment.—The object was to determine whether upland rice could be grown successfully under lowland conditions or not.

The test was made in 1916 with Inantipolo and Calibug upland varieties with Minatanda lowland variety.

From this test the upland varieties used did not produce good yields. There are, however, some upland varieties that can be grown under both upland and lowland conditions, like Lubang Blanco and Lubang Pula.

CORN PROJECT

The corn project was started at this station since 1914 with three experimental jobs and increased to five in number. The following are the experimental jobs:

1. Seed longevity tests.
2. Acclimatization tests.
3. Ear-to-the-row tests.
4. General Seed selection.
5. Variety tests.

Seed longevity tests.—The object of this test is to determine how long it takes the seed corn to lose its vitality by storing it in available containers.

This experiment was started since January, 1922.

Six varieties viz. Baluga yellow, Cagayan yellow, Calamba, yellow, Bohol white, Cebu white, and Moro white were used. Monthly germination tests were made in shelled and unshelled materials.

From one test it has been found that it is better to store the seed corn in ears than in shelled form. Seed corn could be stored ten months after harvest in ears in seed cans.

Acclimatization test.—This test has been started since 1916 with varieties from different provinces of the Islands.

The seeds of each variety were planted separately so as to avoid cross pollination between different varieties.

From four tests there have been found varieties, namely, Baluga yellow, Cagayan yellow, Calamba yellow, Bohol white, Cebu white, and Moro white well adapted to this place. These varieties have been distributed to corn growers in Negros and elsewhere.

Ear-to-the-row tests.—The object in view is to isolate the high yielding strains within a high yielding variety.

Results from 1920 with Cebu white and Cagayan yellow show that the strains isolated produced higher yield than those unshelled strains. The strains isolated are being planted at Lamao Experiment Station, Lamao, Bataan.

General seed selection.—The object is to select only pure seeds from the best plants in the field for next planting season.

This work was started since 1914. Most seed corns are admixtures of red and white kernels. This is due to the impurity of the seed used for planting and the presence of cross pollination of the different varieties of corn.

As a result of this work we obtained good yielding and pure seed corn of different varieties. These are being used fur study of the characters, etc., and for multiplication and distribution to the corn growers in Negros and elsewhere.

Variety test.—The object is to determine which corn varieties are high yielders and which are low yielders.

This experiment was started since 1915. Six varieties were used. Each variety was kept pure as possible.

From the five tests made it has been found that Beluga yellow and Cagayan yellow are the highest yielders and that the Bohol white is the lowest yielder.

Calamba yellow, Cebu white, and Moro white are found also high yielders and are also recommended for planting to corn growers in Negros besides Baluga yellow and Cagayan yellow.

COFFEE PROJECT

The object was to test whether coffee plants will grow in this place.

Different varieties of coffee plants were planted at this station since 1916 at a distance of from 2.7 x 2.7 meters to 4 x 4 meters apart.

Most varieties in 1916 were found growing successfully and producing plenty of berries.

Robusta, Uganda, Canephora, Abeocuta, and Excelsa are the example.

Plenty of seeds have been distributed from these plants.

ROOT CROPS PROJECT

During the food campaign miscellaneous root crops have been introduced into this place to test their adaptability and determine their yields.

The following root crops are found to grow well in this place:

1. Sweet Potato (Different varieties).
2. Cassava, *Manihot, Utilisima* Pohl. (8 varieties).
3. Tugui (10 varieties).
4. Ubi (6 varieties).

As they grow successfully variety tests have been conducted on each crop.

The results of our variety tests are as follows:

1. Mallon P. I. 7344 gave the highest yield per hectare of 28,500 kilos, Linoco P. I. 7341 ranked second yielding 27,333.33 kilos from one test of sweet potato.

2. Kapo white or green variety gave the highest yield being 26,300 kilos per hectare among the eight varieties tested in three tests. Many cuttings were distributed to some hacenderos in Negros and elsewhere.

3. From 1917 to 1922 results on our Tugui variety test, it has been found that Batangas I produces the highest yield among the 10 varieties used.

4. From 1921 to 1922 results on our Ubi variety test, Minan-ug gave the highest yield of 49,500 kilos per hectare. Second was Quinalabao.

VEGETABLES

During the food campaign several kinds of vegetables have been tested at this station as shown in our records, the following are found to grow well at this place:

1. Ampalaya.
2. Asparagus.
3. Cabbage, Chinese.
4. Cabbage, Henderson Summer.
5. Cabbage, Copenhagen market.
6. Dill.
7. Endive.
8. Lettuce, Big Boston.
9. Lettuce, May King.
10. Musk melon.
11. Okra.
12. Patola, Castila.
13. Patola, Tagalog.
14. Patola, Binalingbing.
15. Pepper, Bell.
16. Pepper, *Anahuin.*
17. Pechay.
18. Pechay *proper.*
19. Radish.
20. Radish, Daikon Mikado.
21. Radish, Japanese.
22. Radish, Sakuna, jornamammoth.
23. Rape.
24. Roselle, *Anchor.*
25. Roselle, Rico.
26. Squash, Boston.
27. Squash, long native.
28. Squash, round white.
29. Upo.
30. Cucumber, prolific sort.
31. Cucumber, Indian Nepeul.
32. Cucumber, green variety.
33. Cucumber, Rungpur.
34. Cucumber, Telegraph.
35. Eggplant, Long Purple.
36. Eggplant, short.
37. Eggplant, white.
38. Atabo, black.
39. Batao, white.
40. Bean, Early June.
41. *Centorsema Plumore.*
42. Kibal, white.
43. Large hybrid.
44. Lamao white.
45. *Liar bean.*
46. New era cowpea.
47. Patani.
48. Pole bean, large.
49. Seguidillas.
50. Tahore.
51. Utang.

FORAGE CROP PROJECT

This project has been started since 1914 to meet the demand for forage.

Several grasses, such as *Alfalfa grass,* Bungalon grass, Guinea grass, Para grass, Natal grass, Napier grass, Spineless cacti, Uba or Japanese cane, Rhodes grass, Sudan grass, Beggar weed, and Carpet grass have been introduced here. Out of these forage crops, the following are found to be adapted to this station and are good for animals:

1. Guinea grass is the best forage crop. It can be grown easily and monthly cuttings can be gathered. It is succulent and relished by animals. It is best for an hacendero to have at least a hectare of this forage for his work animals.
2. Bungalong grass is good only under lowland condition for carabaos.
3. Para grass is next to Guinea grass. It is very easy to grow. Just plant the cuttings and after the plants have covered the ground no cultivation is needed. It is succulent and is readily eaten by animals.
4. Japanese cane needs good care but gives good returns. When the plants are young they are very good for animals. If plants are cut from the base they shoot readily.
5. The Sudan grass was found to be also useful as a forage crop at this station but at present there is none under cultivation at this station.

ABACA PROJECT

This project was started since 1915 with the object in view of finding what varieties are suited to this place and give high per cent of fiber.

The following experiments then have been conducted with good results:

1. Variety tests.
2. Suckers *vs.* Seedling tests.

Variety tests.—The object is to determine the per cent of fiber from the stalks of different varieties of abaca.

Ten varieties from Mindanao, eleven from Leyte, five from Negros, and nine from Southern Luzon were used. Only ten hills of each variety were selected for the test. The stalks were harvested after the flower bud has appeared and were weighed. The fiber obtained from each stalk was kept separate from each

other, then dried and weighed to determine the per cent of dry clean fiber from the weight of the stalk.

From the results obtained it has been found that among the 35 varieties of abaca the following are the best yielders:

	Per cent of fiber
Mindanao varieties:	
1. Tangongon	2.106
2. Bangalanon	2.103
3. Sinab-á	1.737
Leyte varieties:	
1. Mininonga	1.728
2. Libutanay	1.604
3. Laguis	1.531
Negros varieties:	
1. Lono	1.082
2. Moro	1.058
3. Bisaya	1.022
Southern Luzon varieties:	
1. Sugmod	1.376
2. Bulao	1.374
3. Canorahan	1.369

From the above it can be seen that the Mindanao varieties gave the highest per cent of fiber, the Leyte second, the Southern Luzon third, and the Negros the lowest.

In connection with this variety test flowering age was also observed to determine how long it takes for each variety to mature.

It has been found that some varieties are late and some are early.

The following are the results:

Section	Early varieties	Late varieties
Mindanao	Libuton, 787 days	Tangongon, 1,219 days.
Leyte	Lagurhuan Dogami, 686 days	Laguis, 1,535 days.
Negros	Kalao, 515 days	Moro, 937 days.
Southern Luzon	Ilayas, 565 days	Bulao, 1,047 days.

Suckers vs. Seeds.—The object is to determine which is better to plant suckers or seeds.

From the 12 varieties tested, it has been found that those plants grown from seeds have very variable fiber contents. Some stalks were found to yield no fiber at all. Some, however, have very high fiber content. Due to this variability in the per cent of fiber of plants grown from seeds, those plants grown from suckers gave higher per cent of fiber per stalk on the average than those grown from seeds.

It has been observed that suckers of these plants planted from seeds are less susceptible to heart rot disease of abaca than those suckers of the plants grown from suckers.

MAGUEY AND SISAL PROJECT

This project according to records was started since 1916.

The following experiments have been conducted at this station with good results:

1. Suckers *vs.* Bulbils.
2. Method of fiber extraction.

Suckers vs. Bulbils.—The object is to find out which one gives better yield of fiber.

Mature leaves of maguey and sisal grown from suckers and bulbils, were used and then each leaf was split into 4 or 5 parts. The pieces of leaves were bundled and immersed in fresh running water.

The data show that the percentages of fiber from plants grown from suckers were higher than those grown from bulbils. It was also observed that the leaves of plants grown from suckers were larger than those grown from bulbils.

Method of fiber extraction.—The object was to find the best method of extracting fiber from maguey and sisal leaves.

The methods used are:

1. Entire leaf *vs.* Split leaf.
2. Salt water *vs.* Fresh water and knife stripping.

Entire leaf vs. Split leaf.—The object is to determine which method is the easiest and gives the highest per cent of fiber.

The maguey and sisal leaves were divided as follows: First group—entire leaves of each kind were bundled and retted; second group—maguey and sisal leaves split into halves each; third group—maguey and sisal leaves split into 4 parts; fourth group—maguey and sisal leaves split into 6 parts; and fifth group—maguey and sisal leaves split into 8 parts.

It has been found that the more the leaves are split into small pieces the shorter it took for them to ret in water or until the fiber was ready for extraction. And in one test it has also been found that the smaller the leaves were split the higher the percentage of fiber was obtained.

Salt water vs. Fresh water and knife method.—The object was to find which is the best method of retting maguey and sisal leaves in order to obtain the highest percentage of fiber.

The following methods were used for extracting the fiber:

1. Knife stripping process similar to the native method for extracting abaca.
2. Salt-water retting process.
3. Fresh-water retting process.

Under the first process the fiber was washed in water after stripping and then dried to remove the greenish color remaining on the fiber.

From the data obtained, the salt-water retting process gave the highest percentage of fiber, the fresh-water ranked second and the knife-stripping process, the third.

MISCELLANEOUS HORTICULTURAL PROJECT

The object was to determine whether fruit trees would thrive well at this station.

Our records show that this project was started since 1915. Many fruit trees have been introduced here from the different countries.

Among those introduced, ates, atemoya, avocado, carambola, babana, camansi, guava, lemasa, phalsa, and sefalus have been found to thrive best here.

SUGAR-CANE PROJECT

The only record available for this project dates back since 1916. There were several experiments; hybridization, stool-to-the-row test, bud selection, fertilizer test, distance of planting, miscellaneous cultural treatment, and miscellaneous experiments.

Hybridization was begun in 1921. The object in view of this experiment was to obtain a variety or varieties that may suit the planters in the production of sucrose and fiber content. Under this experiment two methods were employed; artificial (emasculation of the cane flowers) and natural hybridization (panicles of the varieties to be crossed are placed in a bag in such a position that the pollen of the arrow of the male variety was shed to the flowers of the female variety).

Though no results were obtained as yet in this work, it is expected that in the future this will give a great benefit to the cane planters.

The production of seedling varieties from the promising canes, is going to be carried out as this is more practical than artificial and natural hybridization. This practice promises to give excellent results in the matter of creating superior varieties. Some

of our seedlings show new strains which are quite different from the mother plants.

Bud variation.—This experiment has to be put under the experiment under stool-to-the-row test as they practically aim the same point of view. However, bud mutation has to be observed. For instance in the case of Big Tanna, 3,525, there appears a spot of white variety which is similar to Yellow Caledonia. This is confined to nursery and considered a new variety. This kind of experiment takes several years before satisfactory results are obtained.

General seed selection.—Under this experiment the points are selected and the small ones and those infected with diseases are discarded. A good result was obtained. If the present mosaic disease in some districts in Negros is not controlled, it is likely that the planters in that locality will look for these selected seeds or points in the station not very long.

Variety test.—This experiment has benefited already many farmers in Negros. Only those varieties which are very promising are recommended to the planters giving them information as to the yield of sucrose and fiber content. Badila, Goru, H–109 and Barbados are the most looked for by the planters. The distribution of these tested varieties are of great help to the farmers especially in those district where the cane has degenerated and been badly affected by diseases in which case the local variety has to be changed.

Fertilizer test.—This experiment is very important for the farmers to know. The object is to find which kind of food elements are needed by the plants. This experiment ought to be done in different places in Negros as different districts may need different kinds of fertilizers. As our resources are very limited, our work in this line is confined to this station alone. Our results here may be used as a guide by the planters. It is but lately that the use of commercial fertilizers is generalized. The "Big Crop" fertilizer of the Sugar Central Agency has become very popular that almost every planter in Negros asks for it. The "Big Crop" is a mixed fertilizer containing 9.51 per cent nitrogen, 4.95 per cent phosphoric acid and 3.76 per cent potash. This fertilizer is good only for general purposes and not for specific cases. In many places only nitrogen is needed in which case the application of phosphoric acid and potash is only wasted. The use and application of fertilizers

to the worn out and poor soil can best be studied by the farmers themselves in their own fields and a big economy in time and money can be introduced into his own hacienda.

CONCLUSION

In conclusion it may be considered that the main work of the station at present is confined to sugar-cane experimentation and to raising of live stock. This is done in order to meet the demand of the Negros planters in particular. Since the adoption of the new policy of the Bureau, eight hectares of land were planted with cane in 1922. On December 1922, all the fields were planted. The cane is found in excellent condition and the estimated average yield is about forty tons to the hectare.

Planters who visit the station and see our cane leave nothing but praise to our promising varieties. They request especially Badila points.

Live stock in the station is the attraction of the public. The purpose in keeping and in raising the Indian breed of cattle is to help the farmers in possessing this strongly resistant animals to rinderpest. Day by day the farmers buy young calves for breeding purposes. The pure bred is crossed with the native cows. The result is mestizo. The half-breed served very well as work bullocks. The station is keeping 20 work bullocks. The superiority of this mestizo over the native is questioned by the farmers. Recently, however, Mr. Marciano Araneta of Bago, Occidental Negros, who obtained authority to buy 10 mestizo work bullocks from the station was so pleased with the services rendered to his farm by these animals that he wants to get all the mestizo work bullocks he can buy from the station. The station can meet the demand of the planters in Negros by keeping these two projects alone; sugar cane and animals.

THE TANAUAN CITRUS STATION AND ITS WORK

By JOSE DE LEON
Superintendent, Tanauan Citrus Station

In the opinion of the citrus fruit growers of Tanauan and Santo Tomas, Batangas Province, the eruption of the Taal Volcano in 1911 brought about the decline in the fruitfulness of their mandarin orange groves. It is claimed that the lava from the volcano was deleterious to the trees, and that, where it fell thickly, it caused fatal results to them. Moreover, it is also believed that the continual emission of smoke from the volcano previous to the eruption had favorably influenced the fruiting of the trees, and when this supply of smoke disappeared, after the eruption had taken place, the fruiting of the trees had consequently suffered.

Just how much truth there is in these assertions is quite difficult to tell, because, shortly after that event came a drought which undoubtedly, caused much, though unsuspected injury to the groves. Moreover, the general dissatisfaction among the growers soon after the eruption, has brought other causes of injury to the groves; such as, neglect, and the increase in the number of diseases and pests. It is generally admitted, however, that the degeneration of the mandarin groves of Tanauan and Santo Tomas began just after the year of the eruption.

The seriousness of the situation was soon realized that in 1912 and 1913, investigations of conditions in the citrus district were made by the Bureau of Agriculture. In an attempt to improve the devitalized groves, an agent was temporarily detailed to help the growers. Pruning and tree surgery were the means employed to save the trees. The value of this work has been appreciated by the growers, although, unfortunately, not enough to revive their former faith and interest in the mandarin orange industry.

The Government has not lost sight of the difficulties encountered by the growers of Batangas, who are the principal producers of citrus fruits in the Philippines. In 1919, it has established the Tanauan Citrus Station, solely for the study of the citrus situation with the object of finding remedies for its improvement. It was for this purpose that a typical rundown

and neglected grove was selected as a suitable material for the work. However, much of the work as it is undertaken, at present, is of general interest to citrus growing in the Philippines.

The Tanauan Citrus Station is located on the provincial road, two kilometers south of the town of Tanauan, Batangas. The soil of the station is a clay loam underlain by an adobe subsoil. Although this soil is considered inferior to the deep, light loamy soils of the coastal region of Lake Taal, it nevertheless represents the average soil conditions of a greater portion of the citrus district in Batangas.

The activities of the station include the testing of introduced varieties as well as selected local forms of the important citrus fruits; studies on the cultural and fertilizer needs of the mandarin orange; practical demonstration of the value of top-working in the rejuvenation of mandarin orange trees; studies of the methods of combating diseases and insect pests of citrus; and the propagation of citrus plants for distribution to the public.

In an effort to find out which varieties of citrus do best under Batangas conditions, the station has planted a collection of the most important varieties available. At present, 93 introduced varieties and 30 local selections of commercial citrus are being grown in the station. A few of these varieties are also being grown under the coöperative trial plan, in different parts of the province. These varieties are being tested with regard to their adaptability to the soil and climate, quality of fruit, bearing habits, and resistance to diseases and insect pests. It is hoped that the outcome of this work will be of value not only to this province, but also to others having a similar type of climate.

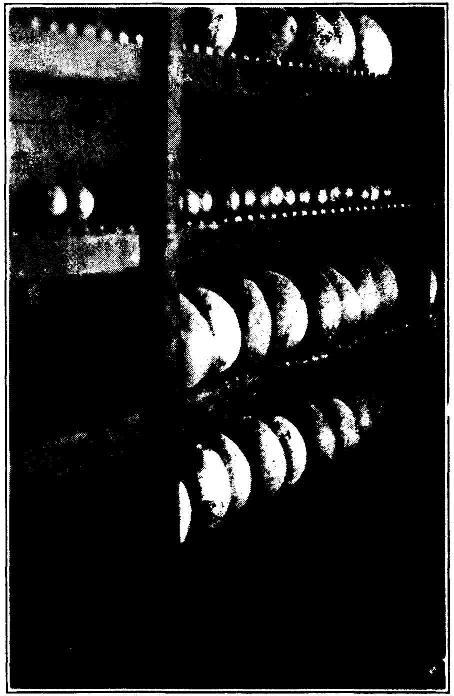
The studies on the cultural and fertilizer requirements of the mandarin are carried on in the station's grove, which contains some six hundred trees twenty years old. Here the most approved methods of tree pruning are practised, suitable cultural treatments of the grove sought and the value of the different fertilizers tested, in an effort to restore a degenerated grove to its former state of productiveness.

In connection with the rejuvenation work, top-working has been practised. Upwards of fifty citrus varieties are grown to determine their value for renovating the tops of old, unproductive mandarin trees. The results of our first attempts in this work have demonstrated the feasibility of transforming unproductive and weak mandarin trees into vigorous and productive trees by the use of scions that do well on this stock.

(*a*) A view of a portion of the Citrus Orchard. Tanauan, Batangas

(*b*) Citrus Nursery, Tanauan, Batangas

(*a*) Exterior view of the storage chamber



(*b*) View of the interior part of the chamber

The station has been conducting experiments on the storage and curing of citrus fruits. The object of this work is to find a practicable means of preserving the fruits to lengthen the period of time in which they may be marketed. Some interesting results have already been obtained from the use of an underground, ventilated storage chamber. It was found that it is practicable to keep mandarin oranges in this chamber at least six weeks, and to the improvement of their appearance and eating quality. This work is being continued in order to determine the best material for constructing the chamber, and also to find out the best disinfectant for washing the fruit.

The disease particularly responsible for the degeneration of the mandarin groves of Batangas is bark rot. The station has instituted preventive as well as curative measures for the control of this disease in its grove. These measures include the pruning off of diseased twigs and branches, white-washing of trunks with concentrated Bordeux mixture, local applications, on the diseased areas, of disinfectants, after a partial or a complete elimination of the affected tissues. Observations are also made on the effects of different systems of culture and fertilization, with regard to the appearance of the disease.

Since the establishment of the station, a citrus nursery has been in operation to produce budded plants for distribution by the Bureau of Agriculture, and there is a steadily increasing demand for these plants of the exotic as well as the local varieties of citrus the station has.

A DESCRIPTIVE LIST OF MANGO VARIETIES IN INDIA: AN ADDENDA

By P. J. WESTER

A Descriptive List of Mango Varieties in India, first published in this *Review*, Vol. XIII, and later issued by this Bureau as Bulletin No. 36, was believed at the time of its publication to be a fairly comprehensive compilation, including 281 varieties. However, it was only just off the press when I received from the senior author a bulletin entitled *The Book of the Mango*, by Dr. W. Burns, economic botanist to the government of Bombay, and Mr. S. M. Prayag, of the Department of Agriculture, Bombay, India, containing descriptions and line drawings of 88 varieties, most of which were not included in my list. A little later, Mr. S. Percy-Lancaster, Secretary of the Agricultural and Horticultural Society of India, Calcutta, who had received my list, kindly forwarded to me the *Proceedings and Journal* of the Society from 1916 to 1921 which contained a descriptive list of 366 mango varieties—a very large part of which were also unknown to me—prepared by Mr. Percy-Lancaster, who also wrote me commenting on the varieties included in my own list. As correcting certain errors that had crept into the list compiled by me, and also because of the additional information contained therein, the more pertinent parts of this communication are quoted as follows:

"Now as regards the article in the Review,[1] on the 20th of May, 1922, the Society held a mango show, and a firm from South India sent his representative with 75 varieties of mangos for exhibition. Some weighed 5½ to 6 pounds (2,400 to 2,720 grams) and I was told that in normal years these fruits would weigh 8 to 9 pounds each (3,625 to 4,080 grams). The flavor was mild, insipid, and sweet but they were without fiber. * * * As to mango varieties, this is where in India we are up against trouble. Most kinds have been propagated by seed, and in consequence there are many types of the same variety differing in shape, size, color, and flavor.

[1] Referring to Bulletin No. 36, A Descriptive List of Mango Varieties in India, originally published in this *Review*, Vol. XIII, pp. 265–352, 1920.

I happen to have the Indian nobleman who gave Dé his notes re the mangos[2] on the council and spoke to him pointing out the descriptions as they appear in your article. He says that Dé has made many errors. I am making a few corrections, but would refer you to my own notes on these mangos.

Ajwanea is not worth cultivating and is of rather unpleasant flavor, like *Carum copticum* (Damoro).

Alphonso. This has been confused with Pairi, Peterpasand and Bombay. The genuine Alphonso has no beak, (nak), is deep orange in color, thin skinned, and very aromatic.

Atai is a late mango.

Baramashi, (*Baromasia*), though the name is spelt in various ways, is a twice bearing variety annually; in fact one can often get three crops of fruit in one year. It is also called *Dophallia,* "twice bearing," and occasionally separated from *Baramashi.* It has no special merit except that of productiveness.

Belua I have not heard of, but know *Bael Khas* which seems to answer to the description.

Bira is oblong in shape, fiberless, of excellent flavor and very sweet. The original tree is in Bhagwangola.

Bombay. Here again we have a multitude of varieties from seedlings which are apt to puzzle one. The true Bombay shape is given in Figure No. 12, in your article.[3] Though the color varies from green to yellow, the fruit is usually marked with pale yellow dots, which are the chief distinguishing marks. *Bombay, Dr. King,* is a doubtful Bombay for I have tasted it.

The *Brindabani* I had from Malda was an excellent variety and equaled any Bombay variety in flavor.

Bulbulchasm is only grown as a curiosity, for the color of the fruit is very striking, being scarlet like the flower of *Coccinea indica.* It is of ordinary flavor.

Enuria is supposed to be a spontaneous hybrid between *Fazli* and *Langra.*

Fazli, Fasli, and *Fajri,* are variations in name of the same variety but have somehow got distributed as quite distinct types of fruit.

Kachamitha. There must be a dozen different shapes and sizes that are so called, which signifies that the fruit is sweet even when unripe. It is not worth cultivating, for most of those kinds are insipid when ripe.

---

[2] Numerous descriptions in my article were quoted from *A Treatise on Mango,* 1904, by P. C. Dé.

[3] See this *Review,* Vol. XIII, p. 279, 1920.

Kishenbogh and *Krishnabhog* are synonyms.

Langra. Here again we have many variations, but they all resemble one another in shape and flavor, differing in period of fruiting and color.

The true *Malda* is a really fine fruit, but among Europeans the name is used to designate the large fruited kinds of insipid taste, hence a lot of confusion exists.

Sandersha is also a name that has been given to two distinct varieties. Your Plate XVIII shows what is here known as *Polly, Totapari* and *Collector,* and I have just got another fruit from a firm in South India, named *Kilimookoo,* which is the same variety.

Sandurea is identical with *Sindurea,* so named because the fruit is usually splashed with red, the color used by the Hindoos for the *Pooja* marks. Some varieties have received this name from the fancied Sandalwood flavor of the fruit.

Sarvati and *Sharbati* are identical, meaning sirupy, and are "sucking" mangoes; i. e. they contain too much fiber to be eaten with a spoon but are used as a juicy "sucking" fruit.

Stalkart and *Peters* are both types of *Bombay.*

Some of the vernacular names signify shape, weight, etc., and I give these, too, in case you care to keep a record of them as follows:

Amirgola and *Ameercola* are the same name though attached to different varieties.

Amrita-bhog means nectar food.

Monda means a sweetmeat.

Anarua like the pomegranate.

Aswina means ripening in October.

Batasa is a late variety, and like a flattened sweetmeat of that name.

Bhadoe, Bhadurea, Budaya and *Bhadai,* etc., means ripening in September.

Chapta or *Chapte* means flat.

Champa refers to the flower of *Michelia champaca.*

Chickna means smooth.

Chini sukker means sweet, as white clarified, and red, unclarified sugar, together.

Dadh or *Dudh* is milk, referring to the color of the flesh.

Doanti means two-seeded.

Gajria means carrot-like.

Gola means round.

Golab-khas means true rose, and

Golab bash scented like a rose.

Guria or *Gooria* means like unclarified, red sugar which is sold in lumps, before it is converted into "sukker," which is grainy.

Hsapeti is the same as *Ilsapati* or *Hilsapati.*

Jalibhanda means tied with netting, referring to the netted marking on the inside of the skin.

Kachmahua might refer to the unripe fruit of *Bassia latifolia,* (Mahua) but of this I am not quite certain.

Kakaria, Kakoria, and *Kakria* means cucumber-shaped.

Kala is black.

Kalua like a plantain or banana.

Karbhuza, etc., like a cantaloupe, *Cucumis melo.*

Karelia means like *Momordia charantia.*

Kapuria, like camphor.

Kartika, fruiting in November.

Kath-ambi means acid mango.

Khajha, like a sweetmeat of that name.

Khaparia, like a head.

Kumrajali, as large as a pumpkin, netted.

Kysapati is: What a leaf! meaning rather vague.

Ladua, like a round sweetmeat of that name.

Lamba Bhadra is a long fruit borne in September.

Lat-Kampi, Lord of the plains.

Lerrua is also known as *Ladua.*

Madhua, like honey.

Mithua, sweet.

Misribhog, sweet food.

Misrikund, sweet, like crystallized sugar, candy.

Mulgoa and *Mulgoba* are identical names though applied to distinct varieties.

Nakua and *Nucka,* with a nose or *nak, daghi* marked.

Naspati, apple-like.

Pansera, weighing five seers, or 10 lbs.

Peters is a Bombay variety.

Rang bahar means showy color.

Safeda or *Sabza,* white or whitish.

Singra, like a horn.

The mango is a pretty large subject (and I suppose that were I to live to be a hundred years old and managed to get in touch with every province in India, still there would be some good varieties overlooked. I thought that when I had made descriptions of my first 100 varieties I knew all the different sorts of

mangos in India, but now I have a list of some 500 kinds—of which, however, there are a good many synonyms and seedling variations—and am now moving on the six hundreds, and "still there are more to follow."

The descriptions of the fruits in the two lists by Burns and Prayag, and by Percy-Lancaster, are more detailed than any previously published by Anglo-Indian writters, and so give the reader a better idea of what India has in the way of mangos than do previous publications on the subject from that country. But they also confirm my previously expressed opinion that a large number of the mango varieties in India are mere curiosities of very little commercial value. For instance, of the 89 varieties included in the list by Burns and Prayag 21, or nearly one-fourth, do not reach 200 grams in weight, four weigh less than 100 grams and two less than 75 grams. For comparison it may be said that the average weight of the Philippine Carabao mango is 230 grams, with a maximum of 560 grams, and that of the Pico mango 215 grams, with a maximum of 460 grams, while the Pahutan averages 96 grams in weight. Many of the varieties described are said to be fibrous, of poor quality, turpentiny, or to have a disproportionately large seed; others have an uncouth unattractive form. No mention is made of the prevalence of fiber in many sorts which leaves one in doubt as to the real merit of the fruit. Considering the number of good fiberless varieties available, certainly no mango so fibrous that it cannot be eaten with a spoon has a future, and it is believed that only in the case of exceptionally good varieties would fruits weighing less than 200 grams be acceptable in the trade when mango growing shall have become an organized industry.

In the within article mangos weighing less than 200 grams are classed as small; they are classed as of medium size when they weigh from 200 to 500 grams; large, when they weigh from 500 to 900 grams; and very large when they exceed the latter weight.

As being of value to prospective importers and planters of mangos, and complementing my previous list, the following brief descriptions have been adapted from the two publications referred to in the belief that they are the "cream" enumerated and described therein.

The following varieties listed by Burns and Prayag in *The Book of the Mango:*

Dalimbya (from *Nandgaon*).—A medium large fruit, weighing 354 grams, deep yellow to light orange; flesh fiberless and of good flavor; seed small, 32 grams in weight.

Dalimbya (from *Khed-Shivapur*).—A medium sized fruit weighing 300 grams, orange to pomegranate-red; flesh fiberless and of good quality; seed small, 29 grams in weight.

Kelya.—A medium sized fruit with a prominent beak, weighing 326 grams, yellow; flesh of excellent flavor; seed small, 30 grams in weight.

Madan-Ban.—A large fruit, weighing 584 grams, yellowish green; flesh fiberless and of excellent flavor; seed comparatively small, weighing 37 grams.

Pairi.—A medium sized, short-ovoid fruit, weighing 360 grams, green to yellow, bright red on sun exposed shoulder; flesh almost fiberless, and of excellent flavor, but of poor keeping quality.

Rawanya.—A heartshaped fruit of medium size, weighing 355 grams, green, shaded with canary yellow; flesh of excellent flavor; seed small, 31 grams in weight.

Among the varieties described by Percy-Lancaster in the *Proceedings and Journal of the Agricultural and Horticultural Society of India,* the following sorts would appear to be the best. The numbers in parenthesis are those given to the corresponding varieties in the said publication:

Alipasand (*291*).—A medium sized, oval-falcate fruit, 90 millimeters long, 63 millimeters in diameter, weighing from 285 to 480 grams, deep lemon; flesh very sweet and aromatic, of delicious flavor recalling the guava; seed thin.

Amritsar (*66*).—A short-oblong fruit of medium size, 90 millimeters long, averaging 283 grams in weight, greenish yellow, with bright yellow cheeks and a small conspicuous beak; flesh fiberless, soft, very sweet, and of delicious flavor.

Barashia (*270*).—An ovoid fruit, 115 millimeters long, 100 millimeters across, weighing from 285 to 455 grams, dark orange; flesh very sweet, of peculiar pleasant flavor, fiberless; seed thin.

Batajora (*194*).—An oblong-ovoid fruit, 140 millimeters long, 75 millimeters in diameter, weighing an average of 425 grams, with a prominent, pointed beak, and dull, dark green skin; flesh firm, sweet and fiberless, with a large proportion of flesh to the seed; seed long and very thin.

Bele Pratab (*157*).—A medium sized, ovoid fruit with distinct beak, 100 millimeters long, 75 millimeters in diameter, weighing 227 to 283 grams, orange yellow; flesh soft, very sweet, of delicious, delicate flavor; seed very thin, flattened at the base.

Bettiah (*Bombay Bettiah*) (*39*).—A round-ovoid, large fruit, from 565 to 850 grams in weight, orange colored to tinged with

green, and black dots; flesh firm, very sweet, and of delicious flavor.

Bhoota Bombay (*11*).—An almost round fruit of medium size, weighing 311 grams, very green to yellowish at apex; flesh fiberless and of excellent flavor; seed long and very thin.

Bogol-Sha (*273*).—An oblong-oval, medium sized fruit, 140 millimeters long, 75 millimeters broad, weighing 283 to 455 grams, deep orange shading to green; flesh sweet, of delicious flavor, somewhat resembling Bael, *Aegle marmelos*, aromatic; seed thin.

Calcutta (*Maldah*) (*89*).—A medium sized to large, ovoid fruit, 125 millimeters long, 100 millimeters in diameter, weighing 340 to 510 grams, bright yellow shading to vermillion at base; flesh fiberless, firm, and sweet, with an agreeable acid flavor; seed of average size, thin at base.

China Fusli (*317*).—A rather small to medium, oblong-oval fruit, 115 millimeters long, 90 millimeters in diameter, averaging 285 grams in weight, greenish to yellow on the sides; flesh firm, sweet, melting and of fine flavor; seed thin.

Chota Jehangir (*345*).—An ovate fruit of medium size, 125 millimeters long, 100 millimeters broad, weighing 285 to 340 grams; lemon chrome tinged with green; flesh very sweet and luscious, fiberless; seed very small.

Damancha (*96*).— A medium sized to large fruit, 100 millimeters long, 75 millimeters broad, weighing 340 to 565 grams, with bright yellow cheeks, shading to green; flesh fiberless, very sweet and of delicious flavor; seed thin.

Dharma, (*Sufaida, Derrima, Durma, Chapta*) (*87*).—An ovoid fruit of medium to large size, 340 to 510 grams in weight; flesh almost free from fiber, firm and sweet, with the flavor of vanilla; seed of average size.

Dilpasand (*266*).—A medium sized fruit with distinct beak, 125 millimeters long, 90 millimeters across, weighing from 283 to 453 grams, orange colored; flesh very sweet and of delicious flavor, fiberless, quite aromatic; seed of average size.

Fusli (*16*).—An oblong-ellipsoidal, medium to large fruit, from 285 to 900 grams in weight, dark-green; flesh firm and sweet, with a tinge of acid.

Golab Khas (*115*).—An ovoid, handsome fruit of medium size, 88 millimeters long, 63 millimeters in diameter, weighing 255 to 340 grams, pale green, flushed with scarlet, and white dots; flesh almost devoid of fiber, firm, sweet and aromatic, and of excellent flavor; seed thin.

Himayuddin (*278*).—A medium to quite large, oval fruit, sometimes 150 millimeters long, and 115 millimeters in diameter, weighing from 285 to 565 grams, bright orange shading to greenish yellow; flesh very sweet and luscious and in large proportion to the seed, which is very thin.

Jalal Sahib (*340*).—A medium sized, oblong-falcate fruit, 165 millimeters long, 115 millimeters in diameter, averaging 395 grams in weight, greenish yellow to chrome yellow on the cheeks; flesh firm, subacid, of delicious flavor, fiberless, seed of average size.

Kalamocha (*271*).—A medium sized to quite large fruit, 140 millimeters long, 90 millimeters broad, weighing from 455 to 565 grams, dark orange; flesh very sweet, aromatic, of fine flavor, slightly fibrous; seed thin.

Kysapati (*12*).—A medium large, ovoid fruit weighing from 340 to up to 425 grams, with a prominent beak, lemon yellow to greenish at base; flesh fairly firm and of fine flavor.

Langra (*43*).—An almost round, rather large mango, 10 centimeters long, 90 millimeters across, weighing 567 to 680 grams, yellow, tinged with green; flesh firm, and subacid in flavor; seed very thin.

Latkumpu (*Lat Kuspu, Mahadeb Prasad*) (*33*).—An ovoid-oblong, rather large fruit, weighing 453 to 735 grams, orange yellow to greenish; flesh slightly fibrous, firm, sweet, with the flavor of *Dillenia indica*.

Mulgoa (*183*).—The fruit is nearly round, 90 millimeters in diameter, 340 to 510 grams in weight, thick-skinned, greenish yellow with cream colored dots; flesh firm, very sweet and of delicious flavor; seed of average size. Reputed one of the best south Indian varieties.

Nadam (*Pasund*) (*248*).—An oblong-oval fruit, 140 millimeters long, 90 millimeters across, weighing 283 to 340 grams, orange colored, shaded with green at base, the skin thick; flesh firm and juicy, very sweet, of delicious flavor, very aromatic and fiberless; seed thin.

Nanihar (*290*).—An oblong oval, medium sized to quite large fruit, 140 millimeters long, 90 millimeters across, and 340 to 565 grams in weight, yellow shading to yellowish green; flesh very sweet and of excellent flavor; seed thin.

Nardusalai (*201*).—A medium sized, round fruit, 90 millimeters in diameter, weighing 340 grams, with distinct beak, green to deep chrome shaded with scarlet; flesh very sweet, highly aromatic, of good flavor and fiberless; seed small and thin.

Nawab Khas? (*165*).—A large to very large, almost round fruit, 125 millimeters long, 120 millimeters across, weighing from 450 to 1,370 grams; chrome yellow to pale green; flesh very juicy and sweet, with enough tartness to make it very fine flavored; seed thin, "depressed" at base and apex.

Nazak Badam (*277*).—A medium sized, oval fruit, 140 millimeters long, 115 millimeters across, weighing 285 to 453 grams, dull orange; flesh firm, very sweet, and very delicately flavored; seed small.

Pride of Russa (*334*).—An oval, yellowish green, fairly large fruit, 115 millimeters long, 90 millimeters across, averaging 310 grams in weight; flesh sweet, juicy and luscious; seed thin.

Radha Bhog (*159*).—A medium sized, ovoid fruit with a pointed beak, 100 millimeters long, 75 millimeters across, weighing 227 to 283 grams, greenish yellow to deep yellow; flesh soft, a trifle acid, and of pleasant flavor; seed thin.

Sodale (*319*).—A fair sized, oblong-oval fruit, 115 millimeters long, 85 millimeters across, averaging 310 grams in weight; flesh very sweet and of delicious flavor; seed small and thin.

Suka (*Sooka, Laddowa*) (*37*).—A round, medium sized to large fruit, 283 to 567 grams in weight, dull yellow tinged with pale green; flesh slightly fibrous, and subacid in flavor.

Tenneru (*338*).—A very large, ovate fruit, 190 millimeters long, 140 millimeters in diameter, weighing from 850 to 1,135 grams, yellow, shaded with orange and green; flesh soft in texture, of pleasant subacid flavor, fiberless; seed long and thin.

Umrao Pasand (*Sha Pasand*) (2).—An ellipsoidal, reddish orange to pale green fruit of medium size, weighing 311 grams; flesh fiberless, firm; and of excellent flavor.

Reviewing then, the descriptions of the grafted mango varieties in the publications mentioned in the within paper it would appear that the following are the best and most worth introducing for trial where they are not now grown:

- Alfonso (several varieties)
- Alipasand
- Amini
- Amiri
- Amritsar
- Barashia
- Batajora
- Bele Pratab
- Benarsi
- Bennett
- Bettiah
- Bhaisht
- Bira
- Bogol-sha
- Bombay (several varieties)
- Bulbulchasm (as fruited in Porto Rico)
- Calcuttia
- Cambodiana
- China-Fuzli
- Chota Jehangir
- Dadh mungo

Dalimbya
Damancha
Dilpasand
Dilsaj
Durgabhog
Durma (Syn. Sufaida, Derrima, Dharma, Chapta.
Fajri Long
Faqirwala
Fuzli (Fusli)
Golab-Khas
Haden
Hathijuhl
Himayudin
Itamaracá
Jalal-Sahib
Kalamocha
Kalapahar
Kartika
Kathambi
Kelya
Khaparia
Kishenbhog
Kohitur
Kysapati
Laldarma
Langra (several varieties)
Latkumpu
Mohunbhog
Madan-Ban
Mulgoa
Mulgoba
Nadam
Nanihar
Nardusalai
Nawab Khas
Nazak-Badam
Pairi
Pride of Russa
Radha Bhog
Rawanya
Sandersha
Sabza
Shapasund
Singapuri
Sodale
Souria
Suka
Surkha
Tenneru
Totapari
Umrao Pasand

CURRENT NOTES—FOURTH QUARTER

Notes by P. J. WESTER

AN EXPERIMENT IN FORCING MANGOS

Smudging mango trees to drive away the mango hopper, *Idiocerus spp.*, and force the trees into fruiting, has long been a common practice in the principal mango district near Manila, and the practice is described and illustrated in Bulletin No. 18, *The Mango,* Revised edition, published by this Bureau. In the *Philippine Agriculturist,* Vol. XII, No. 1, 1923, Mr. Leon G. Gonzales relates his experience in an experiment undertaken to study the effect of smudging the trees and the relation thereof to insect control. Altogether, forty trees were used in the experiment which demonstrated that:

1. The mango can be made to flower by means of smudging at any time of the year, provided the tree is in proper condition.
2. The heat, not the smoke, causes the flowering.
3. The number of flowers produced is directly proportional to the increases in temperature within the limits of safety from burning the leaves.
4. If smudges of less intensity of heat are used, the length of time of smudging should be proportionately increased before flowers will appear and under such circumstances flowering is likely to be less abundant.
5. Smoke drives away the mango hoppers, but they return immediately after the smudging is stopped.
6. The best time for smudging is between October and December, depending upon weather conditions. Smudging should not be done until the rains are over and the weather is settled.
7. Results from smudging are most easily obtained when the last growth is well matured and the terminal buds are well formed.

A SEEDLESS GUAVA

Slowly but surely the fruits of the tropics are being improved. We have learned to propagate many species vegetatively within the last fifteen years that previously were grown from seed as a matter of course, and so are in a position to take advantage of and propagate the exceptional individuals that spring forth now and then among the vast multitude of seedling fruit trees found in the tropics.

So we have found in the Philippines a number of seedless pomelos, mabolos and lanzones, sweet santols, sweet carambolas and kamias.

In the *Proceedings and Journal of the Agricultural and Horticultural Society of India,* for July–December, 1918, the Secretary, Mr. S. Percy-Lancaster, calls attention to a seedless guava of large size which he has discovered in India. This is the first time that a seedless fruit of this species has come to our attention and it is certain to be appreciated by all lovers of the guava who are familiar with the extraordinary seediness of the ordinary guava. There should be no difficulty in rapidly increasing and disseminating this valuable new variety as it has been found that the guava is easily shield-budded if the work is done during the dry season, here from November to May.

INDEX TO VOLUME XVII, 1924

SUBJECTS

	Page
Abaca:	
Administrative Order No. 30	59
Administrative Order No. 38	75
Adlay: Progress Report on Adlay	261
Administrative Order—	
No. 29	52
No. 30	59
No. 31	61
No. 32	63
No. 33	65
No. 34	67
No. 35	70
No. 36	71
No. 37	73
No. 38	75
No. 39	77
No. 44	215
Agronomical Experiments Performed by the Plant Industry Division	167
Anthrax, Disposal of Carcasses of Animals that Have Died of	140
Bamboo: Administrative Order No. 36	72
Barit, Effect of Tobacco Dust and Lime on	10
Breadfruit: The Seedless Breadfruit of the Pacific Archipelagoes	24
Bud-Rot: Administrative Order No. 39	77
Cabbage: Variety Test of Cabbage	207
Coconut:	
Administrative Order No. 31	61
Administrative Order No. 39	77
Coöperative Marketing as a Factor in Improving Our Agricultural Conditions	245
Copra, Manufacture of	101
Corn:	
Comparative Tests of Six Philippine Corn Varieties	195
On the Occurrence of Maize Rust in the Philippines	3
Descriptive List of Mango Varieties: An Addenda	283
Directions for Saving and Keeping Vegetable and Other Seeds	40
Disposal of Carcasses of Animals That Have Died of Anthrax and of Those Dying of Undetermined Diseases	140
Duck Industry in the Philippines	87
Effect of Sunlight on the Germination of Papaya Seeds	21
Effect of Tobacco Dust and Lime on Barit	10
Experiment Station:	
The Past and Present Work of La Carlota Experiment Station	267
The Tanauan Citrus Station and Its Work	279

Page
Experiment in Forcing Mangos.... 293
Experiments on Vegetative Propagation of Tropical Fruits at the Lamao Experiment Station.... 203
Fertilizers, The Use of.... 134
Fiber Grading, Inspection, etc.: Administrative Order No. 44.... 215
Forcing Tropical Fruits.... 79
Fruit Fly: Administrative Order No. 34.... 67
Fungicides, Use of.... 127
Green Manuring, The Use of.... 134
Guava: A Seedless Guava.... 293
Heart Rot: Administrative Order No. 38.... 75
La Carlota Experiment Station, The Past and Present Work of.... 267
Maize Rust, On the Occurrence of.... 3
Mandarin: The Storage and Curing of Batangas Mandarin Oranges.. 120
Mango:
  A Descriptive List of Mango Varieties in India: An Addenda.... 283
  An Experiment in Forcing Mangos.... 293
Manufacture of Copra in the Philippines.... 101
Marketing: Coöperative Marketing as a Factor in Improving Our Agricultural Conditions.... 245
On the Occurrence of Maize Rust in the Philippines.... 3
Papaya: The Effect of Sunlight on the Germination of Papaya Seeds 21
Philippine Tobacco Industry—Suggestions for its Improvement.... 147
Pineapple: Administrative Order No. 35.... 70
Poultry Notes.... 142
Preliminary Report on the Effect of Distances of Planting Wrapper Tobacco.... 237
Preparation and Packing of Seeds and Scions of Trees and Shrubs in the Tropics.... 46
Progress Report on Adlay.... 261
Progress Report on Five New Hybrid Varieties of Tobacco.... 253
Quarterly Notes:
  First Quarter.... 79
  Fourth Quarter.... 293
Raising of Wrapper Tobacco in the Cotabato Valley.... 227
Rice:
  Administrative Order No. 33.... 65
  Size of Seedling Tests with Reference to the Rate of Seeding and Relative Yields.... 13
Root Grubs, Some Observations on.... 109
Root-Rot: Administrative Order No. 38.... 75
Scions: The Preparation and Packing of Seeds and Scions of Trees and Shrubs in the Tropics.... 46
Seeds:
  The Preparation and Packing of.... 46
  Directions for Saving and Keeping Vegetable and other Seeds.... 40
Seedless Breadfruits of the Pacific Archipelagoes.... 24
Seedless Guava.... 293
Size of Seedling Tests with Special Reference to the Rate of Seeding and Relative Yields.... 13

Page

Some Observations on Root Grubs in the Philippines and Suggestions for their Control 109
Storage and Curing of Batangas Mandarin Oranges 120
Sugar Cane: Administrative Order No. 32 63
Tanauan Citrus Station and Its Work 279
Tobacco:
A Preliminary Report on the Effect of Distances of Planting Wrapper Tobacco 237
Administrative Order No. 37 73
The Philippine Tobacco Industry—Suggestions for its Improvement 147
Progress Report on Five New Hybrid Varieties of Tobacco 253
The Raising of Wrapper Tobacco in the Cotabato Valley 227
Turkey Raising 157
Use of Fertilizers and Green Manuring on the Farm 134
Use of Fungicides in the Philippines 127
Variety Test of Cabbage 207
Wrapper Tobacco (See Tobacco).

ILLUSTRATIONS

Facing page—

Adlay 262, 264
Baling fiber 221, 223
Citrus 280
Coconuts 104
Copra 104
Copra drier 104, 106, 108
Corn 196
Ducks 90
Duck shelter 88
Eggs of ducks 90, 92
Fertilizer—Diagram 139
Incubators for ducks 90, 91
Maize rust 8
Pateros ..... Frontispiece, Second Quarter
Receptacle for preserving seeds 45
Snails for duck's feed 90
Tobacco 240, 254, 256, 258, 260
Turkey 160, 162, 164
White grub 110, 114

AUTHORS

ANONYMOUS: Page
Agricultural Experiments Performed by the Plant Industry Division During 1923 167
Current Notes—First Quarter 79
Disposal of Carcasses of Animals That Have Died of Anthrax and of Those Dying of Undetermined Diseases 140
Poultry Notes 142

Page

ASUNCION, SILVESTRE: The Past and Present Work of La Carlota Experiment Station ... 267
BORJA, VICTORINO: The Effects of Tobacco Dust and Lime on Barit... 10
BURGOS, CARLOS X.:
The Duck Industry ... 87
Turkey Raising ... 157
CAMUS, JOSE S.: Coöperative Marketing as a Factor in Improving our Agricultural Conditions ... 245
DE LEON, JOSE:
The Storage and Curing of Batangas Mandarin Oranges ... 120
The Tanauan Citrus Station and Its Work ... 279
DIRECTOR OF AGRICULTURE:
Administrative Order No. 29 ... 52
Administrative Order No. 30 ... 59
Administrative Order No. 31 ... 61
Administrative Order No. 32 ... 63
Administrative Order No. 33 ... 65
Administrative Order No. 34 ... 67
Administrative Order No. 35 ... 70
Administrative Order No. 36 ... 72
Administrative Order No. 37 ... 73
Administrative Order No. 38 ... 75
Administrative Order No. 39 ... 77
Administrative Order No. 44 ... 215
ELAYDA, A.:
Experiments on Vegetative Propagation of Tropical Fruits at Lamao Experiment Station ... 203
The Use of Fertilizers and Green Manuring on the Farm ... 134
GALANG, F. G.: Experiments on Vegetative Propagation of Tropical Fruits at Lamao Experiment Station ... 203
GUTIERREZ, MARIANO E.:
Progress Report on Five New Hybrid Varieties of Tobacco ... 253
The Raising of Wrapper Tobacco in the Cotabato Valley ... 227
HERNANDEZ, NEMESIO: A Preliminary Report on the Effect of Distances of Planting Wrapper Tobacco ... 237
MARQUEZ, FRANCISCO D.: Comparative Test of Six Philippine Corn Varieties ... 195
MORADA, EMILIO K.:
The Effect of Sunlight on the Germination of Papaya Seeds ... 21
Variety Test of Cabbage ... 207
OTANES, FAUSTINO Q.: Some Observations on Root Grubs in the Philippines and Suggestions for Their Control ... 109
PAGUIRIGAN, DOMINGO B.: A Preliminary Report on the Effect of Distances of Planting Wrapper Tobacco ... 237
REYES, GAUDENCIO M.:
On the Occurrence of Maize Rust in the Philippines ... 3
The Use of Fungicides in the Philippines ... 127
SERRANO, N. B.:
The Use of Fungicides in the Philippines ... 127

Page

TOBACCO COMMITTEE: The Philippine Tobacco Industry—Suggestions for Its Improvements ... 147
TORRES, JUAN P.: Size of Seedling Tests with Special Reference to the Rate of Seeding and Relative Yields ... 13
WESTER, P. J.:
A Descriptive List of Mango Varieties: An Addenda ... 283
Directions for Saving and Keeping Vegetable and Other Seeds ... 40
Manufacture of Copra in the Philippines ... 101
Progress Report on Adlay ... 261
Quarterly Notes (No. 4) ... 293
The Preparation and Packing of Seeds and Scions of Trees and Shrubs in the Tropics ... 46
The Seedless Breadfruits of the Pacific Archipelagoes ... 24

○

SUPPLEMENT

OF THE

PHILIPPINE AGRICULTURAL REVIEW

Adriano Hernandez

ADRIANO HERNANDEZ, farmer, soldier, public servant, and editor of the PHILIPPINE AGRICULTURAL REVIEW, was born in Dingle, Iloilo, September 8, 1870. He studied in the Ateneo de Manila, obtaining the degree of bachelor of arts in 1890. He took up the study of law in the University of Santo Tomas, but did not finish the course, for it was not to his liking. Then he engaged in farming in his home province, until 1898, when the Revolution broke out against Spain. He enlisted as a "buck private," rising in a short time to the rank of colonel and the command of the army north of Iloilo. The following month, the Revolutionary Government of Panay promoted him to the rank of Brigadier-General. On December, 1898, he was sent as military envoy to Malolos, the capital of the Revolutionary Government of the Philippine Islands. On March, 1899, in recognition of his ability and valor he was promoted Chief of the General Staff.

On the advent of peace, his home and property destroyed by war, he went to the neighboring province of Occidental Negros, engaging in the purchase and sale of sugar for the Compañia General de Tabacos de Filipinas, as representative for the west coast of the province. He was elected councilor of the town of Silay in 1904, and chairman of the school board in 1905.

On the establishment of the Philippine Assembly in 1907, he was elected a delegate thereto from the fourth district of Iloilo. During his term, he was one of the leading members of the Assembly, being the author of important laws pertaining to agriculture, irrigation, industry, commerce, and labor. He was chairman of the Committee on Industry, Commerce, and Labor, and was a member of the following committees: Appropriation; Banks and Corporations; Agriculture; Relations with the Sovereign Government; Provincial

and Municipal Governments; Labor Accidents; and Irrigation.

In 1912, he was elected governor of Iloilo, and proved to be such a capable executive that he was appointed Assistant Director of Agriculture in 1914. He was assigned to field work and succeeded in ridding the Philippines of locusts for the first time in history. His work along this line was mentioned by General Frank McIntyre, Chief, Bureau of Insular Affairs, in a special report submitted to the Secretary of War covering his visit in the Philippines in 1916, which report says among other things: "There was a widespread commendation of the work being personally directed by the Assistant Director of Agriculture (Adriano Hernandez) in combating them (the locusts)."

In July of 1916 on the retirement of the then Director of Agriculture, Mr. H. T. Edwards, the sentiment in favor of the selection of Mr. Adriano Hernandez to succeed him was unanimous among Americans and Filipinos, and during his incumbency as Director of Agriculture he was instrumental in the establishment of the rural credit system in the Islands, and in the promotion of the agricultural extension, experimental and cattle immunization work of the Bureau of Agriculture. He played a leading rôle in the creation of the farmers' congress which meets yearly in Manila. A short time later, when the Reorganization Act was passed by the Philippine Legislature, creating a Filipino Cabinet, the name of Mr. Hernandez was considered for the new portfolio of the Department of Agriculture and Natural Resources, but he preferred to stay in the Bureau of Agriculture to continue the program of work he had already mapped out and started.

When the United States entered the World War he was commissioned a reserved officer of the Signal Corps of the National Guard, with the rank of Colonel. During the War he waged an energetic food production campaign which proved of great benefit to the Islands aside from its timeliness in forestalling any possible food shortage. Mr. Hernandez was also recently considered to fill the delicate position of Director of the Bureau of Non-Christian Tribes.

His services to the Government were ever of a high order, and recognized as such not only in the Philippines but abroad. The letters which he received in his lifetime from foreign institutions and prominent scientists highly commend his constructive work in the Bureau of Agriculture.

One of the youngest generals of the Filipino Revolutionary Army, being barely 29 years old when he received his commission as such, he was the first Filipino appointed Director of Agriculture and at the time of his death was the only chief of a Bureau, excepting Father Jose Algue of the Weather Bureau, who had rendered more than 10 years' service.

Mr. Hernandez was a hard worker, loyal to his superiors and ever considerate, charitable and sympathetic in his attitude towards his subordinates. His winning smile, his charm of manner, urbanity, tact and kind heartedness made a host of friends for him; and these qualities and his abilities brought him the respect of every one of whatever race, who knew him and his work. All agree that in his death the Government, his people and his country have suffered a distinct loss.

The estimate of his fellowmen may be seen in the following tributes:

FROM HIS CHIEF

I regret to announce the death of General Adriano Hernandez, Director of Agriculture of the Philippine Government, a faithful and devoted public servant.

* * *

General Hernandez was a man of sterling character and he enjoyed the fullest measure of the confidence and respect of his associates in the Government.

LEONARD WOOD
Governor-General of the Philippine Islands

(In a statement given to the press.)

*

* *

FROM A COMRADE IN ARMS

His (Hernandez's) death is a great loss to the Association of Filipino Veterans of the Revolution. He was big-hearted, a great patriot, and a good man. He was always more of a revolutionary veteran than a politician.

EMILIO AGUINALDO
Former Generalissimo of the Filipino Revolutionary Army

FROM HIS POLITICAL OPPONENT

WHEREAS, Providence in its inscrutable wisdom has called from this life the late Adriano Hernandez, Director of Agriculture and Ex-Governor of Iloilo, liberating him from the burden of earthly existence;

WHEREAS, as Director of Agriculture and as Ex-Governor, Adriano Hernandez, ever took a deep interest in all that pertained to his native land and ever devoted himself to her welfare.

WHEREAS, due to the unselfish efforts he exerted during his administration as chief executive of his Province and as Director of Agriculture of the whole Philippine Islands, to bring about public improvements thus greatly contributing to the progress first of Iloilo and then to the whole country,

BE IT RESOLVED, that the people of Iloilo Province, duly represented by the Provincial Board of Iloilo, express their most heartfelt symphathy to the bereaved family of the late Director of Agriculture and Ex-Governor in their great sorrow.

RUPERTO MONTINOLA
Provincial Govetnor.

(Translation of Resolution unanimously passed by the Provincial Board of Iloilo.)

*
* *

FROM A FARMER

The death of Director Hernandez is a distinct loss to the Government and to the country at large. He gave all his best to the Bureau (of Agriculture) and to uplift the interest of farmers.

JOSE ESCALER
Sugar Planter and Former President of the Philippine Farmers' Congress

*
* *

DON ADRIANO HERNANDEZ

[Editorial, February 17, 1925]

The death of Don Adriano Hernandez, Director of the Bureau of Agriculture, veteran of the Philippine Revolution, and former governor of the Province of Iloilo, constitutes a loss which will be deeply felt by all elements throughout the Islands.

Don Adriano served his country and its people faithfully and with a spirit of patriotic devotion well worthy of emulation.

Where others, perhaps, have adopted tactics designed to obstruct he was always an apostle of the constructive. He fought for his ideals as long as he was convinced that by fighting he might better the condition of his people. He accepted peace when it became apparent that through statemanship rather than through the battlefield lay the path to regeneration, prosperity, and happiness. He held responsible positions in the Government because he was convinced that he could there best serve the interests of the Islands as a whole.

He had a breadth of vision, a sympathy in viewpoint, and a notable administrative ability which combined to win for him the admiration of all with whom he came in contact.

His life achievements will forever be his greatest monument.

THE MANILA DAILY BULLETIN
(American Morning Daily)

*

* *

ADRIANO HERNANDEZ

[Editorial, February 17, 1925]

Long, exemplary, meritorious, brilliant was the career of the notable patriot Adriano Hernandez, who has just descended to the grave. Few men can boast before their country of services so distinguished and valuable as this Filipino citizen. * * * A soldier in war time, when peace came he became all that he desired to be, and that was no small achievement. He was elected a representative for his district and became a governor of his province, he was an eminent member of the Veterans' Association and of a long list of civic, cultural, and recreative societies, and lastly he was the Director of Agriculture. It was in this position that he showed himself truly prodigious in activity, zeal, and enthusiasm for public affairs, and gave his knowledge and experience, going from province to province and performing long and difficult trips on land and sea, in which his skin became tanned as in the days of the war. * * *

Another rare gift, almost always reserved only for the descendants of gods, was the winning manners that characterized Don Adriano Hernandez, whose prudence, tact, and affability won him as many friends as there were persons that came in contact with him.

Great were his merits, but * * * suffice it to say that he held in the hearts of his friends, comrades, subordinates, and among the elements he represented and governed, an enviable place. All patriots eager to rise from the multitude should emulate his fine qualities and his services.

The mourning for such a great loss is national, spontaneous, and lasting.

EL DEBATE
(Filipino Independent Daily)

*

* *

ANOTHER PATRIOT GONE

[Editorial, February 18, 1925]

We have to lament deeply the death of a meritorious citizen whose life was devoted to the service of his country in the many posts he filled either by election or appointment.

Don Adriano Hernandez (may he rest in peace) served the fatherland on the battlefield during the sad days of the Revolution, he served her in peace as a member of the Philippine Assembly and as a governor of his province and lastly in the Bureau of Agriculture, whose direction he was in charge of, performing this latter duty most efficiently.

Though we lost by his death a good public official, we gained for our annals another example of good citizenship and of a life devoted to the service of the community.

LA DEFENSA
(Catholic Daily)

*

* *

GENERAL HERNANDEZ

[February 18, 1925]

Director Hernandez was one of the most glorious figures of our Revolution, he held the title of General in the Liberating Army, and once peace was established, he was elected a Representative of one of the districts of the province of Iloilo of which he became later on the governor.

After his term as Governor expired the Insular Government appointed him Director of the Bureau of Agriculture, as a just prize for his revealed merits.

EL COMERCIO extends its sympathy to the sorely bereaved family of the deceased, whose unexpected death drapes in mourning his country and the hearts of his countrymen.

EL COMERCIO
(Filipino Evening Daily)

*

* *

D. ADRIANO HERNANDEZ

[February 16, 1925]

We have lost an old and loyal friend. He was our friend since his youth, and did not leave off being so even during the Philippine Revolution, of which he was one of the leaders in the Visayan Islands towards the end, when we found ourselves on opposite sides. Yet many a time when we had to make arrangements with the Revolutionary armies to settle differences or avoid the shedding of blood, we found in him not the enemy but the noble collaborator, and through his kind-hearted intervention and due to his noble feelings and well-won prestige in both fields much good was accomplished.

Since his boyhood we have followed step by step his life, which was entirely laborious, honest, and patriotic. These qualities and his capacity in all agricultural undertakings, won for him the public posts that he occupied from the beginning of the civil régime. As Director of Agriculture he exercised so much zeal, so much intelligence, gave such careful thought to his work that in spite of the perpetual handicap of limited resources for no administration has ever been prodigal to this important branch of progress he rendered the country a great service and contributed on a big scale to the development attained by the agriculture in the Philippines.

As a gentleman and an honest man he was classed among the best, and this is the reason why in spite of having been a prominent

partaker in political events, which always provoke passions, he never had an enemy; none ever felt resentment against him of all those who had been on the other side.

Like his brother Julio, who preceded him some years ago to the Great Beyond, he belonged to the generation of Ilongos worthy of their country's admiration, by the wide-awake intelligence with which they devoted themselves to her, and the exemplary civic spirit that inspired them in all their actions.

Our friendship plants over his remains the evergreen of remembrance, and weeps with the family of the deceased this loss that severs from the tree, once tufted and luxuriant, which we planted on arriving at the shores of this country, one of its most beautiful branches.

EL MERCANTIL
(Spanish Daily)

*
* *

A GOOD PATRIOT, A GOOD EXECUTIVE, AND A GENTLEMAN

[Translated from Spanish Section, February 21, 1925]

In war and in peace he served the fatherland with faith, with tenacity and with a blind adoration. Thanks to his tact and acumen and numberless glorious deeds with the sword, he was soon promoted during the Revolution to the post of General of the Revolutionary armies in Iloilo, a high command, the duties of which he performed with great ability and to the general approbation, that won for him the love of friends and opponents alike. * * *

PHILIPPINES FREE PRESS
(American Weekly)

*
* *

ADRIANO HERNANDEZ

[Editorial, February 17, 1925]

With the death of General Adriano Hernandez, Director of the Bureau of Agriculture, the Insular Government has lost one of its ablest officials, and the Filipinos a good friend, of a frank and open character—a loyal countryman.

Director Hernandez was in charge of the Bureau of Agriculture from the beginning of the era of Filipinization, and with his especially winning manners he was able to overcome the prejudices of those who, probably in good faith, believed that such a policy was a little premature. It was due to this quality that instead of provoking resistance and animosity on the part of his colaborators, Filipinization produced harmony and good will. For the first time a Filipino from the south, who had a practical knowledge of the agriculture of his country was called upon to dedicate to the service of his people his knowledge, and labored successfully for the development of agriculture to develop Filipinization initiative as far as

possible. He traveled through all the provinces of the Archipelago, determined to know the agricultural situation of each region. He stayed in this job until his sickness robbed him of his energies to continue his work. As a Filipino he did not shirk from the Revolution in the fateful days of our Republic, sacrificing part of his personal fortune and his peace for his convictions. During peace he showed himself a fervent supporter of established institutions, without renouncing his principles.

Of his goodness, of the precious gems of his character as a citizen, as a Filipino, and as a public official, we keep a pleasant and enduring memory.

LA VANGUARDIA
(Filipino Independent Evening Daily)

*
* *

ANOTHER PATRIOT GONE

[Editorial, February 17, 1925]

Adriano Hernandez left behind him the best example of what the Americans call service—a virtue which few men of these days practice with the necessary love, devotion, and constancy.

It was service that Don Adriano Hernandez rendered to his country during those glorious but anguished days of our Revolution when he offered his services for the defense of his native land. It was service that he rendered to his province during his administration as provincial governor thereof. In short, his whole life was service. * * *

EL CENTINELA
(Filipino Daily, Iloilo)

*
* *

FROM AN AMERICAN RESIDENT

Your loss is great; but the loss to the Filipino people is greater. Your husband left an example of service to all Filipino youth as he gave his life for his country. He was a true friend to Americans and American ideals without forgetting the loyalty due to his country.

C. B. SAWYER

(In a telegram sent to Mrs. Hernandez.)